New Jersey Department of Environmental Protection
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Water Monitoring and Standards
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REAPPRAISAL OF

SHELLFISH GROWING AREA SE-4:

CROOK HORN CREEK TO WHALE CREEK

2000-2004

January 2008

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REAPPRAISAL OF
SHELLFISH GROWING AREA SE-4
CROOK HORN CREEK TO WHALE CREEK
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New Jersey Department of Environmental Protection
LISA P. JACKSON
COMMISSIONER

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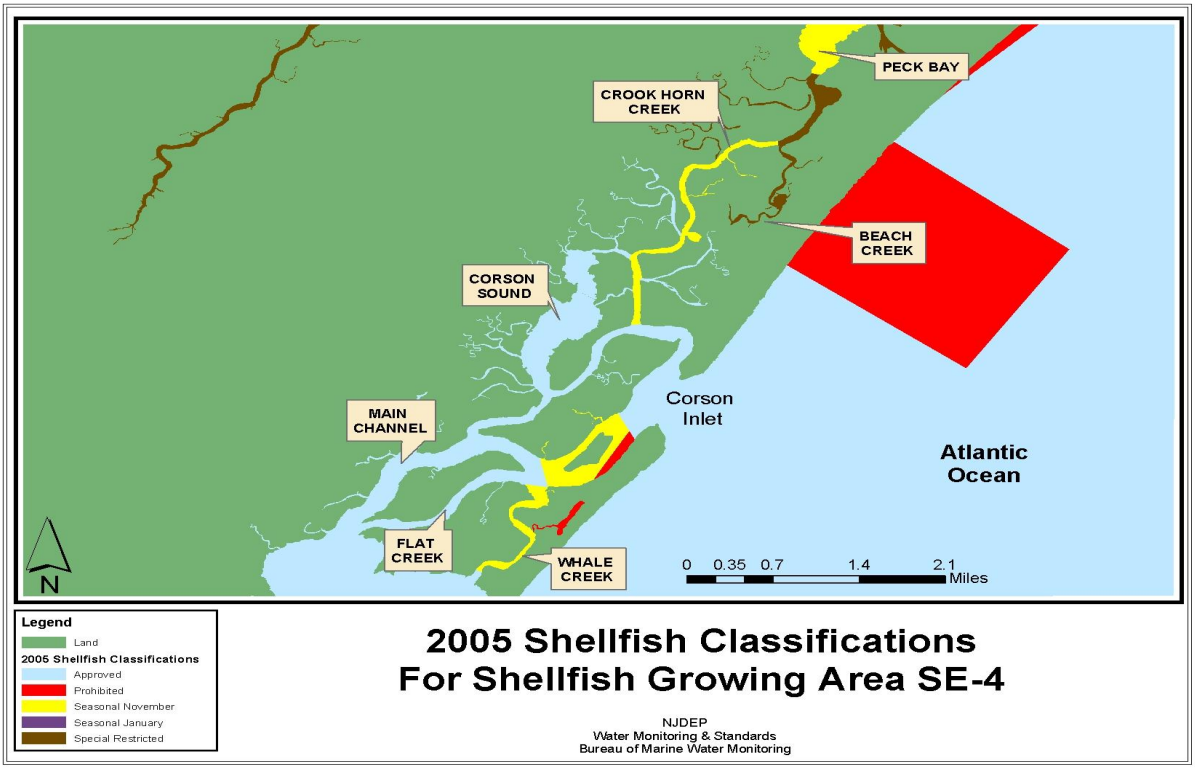
EXECUTIVE SUMMARY

Shellfish Growing Area SE-4 is located in Cape May County, New Jersey. This growing area is situated between Peck Bay and Ludlam Bay. The current shellfish classifications for Shellfish Growing Area SE-4 are *Approved* (year-round), *Seasonally Approved (November to April)*, *Special Restricted*, and *Prohibited*. The water quality data presented in this Reappraisal Report of Shellfish Growing Area SE-4 were collected between July 2000 and September 2004 using the Systematic Random Sampling Strategy (SRS). Approximately 1,978 water samples were collected from 51 sampling stations and tested for total coliform bacteria. The data analyzed for this report indicated that all sampling stations were in compliance with NSSP Total Coliform Approved and Special Restricted criteria. According to the statistical analysis, there were sampling stations affected by season, tide, and rainfall. However, the levels of bacteria recorded from these sampling stations were minimal and were still in compliance with NSSP specifications. All sampling stations met theirs current classifications of *Approved*, *Seasonally Approved, Special Restricted and Prohibited (see Figure 1)*. It is recommended that this shellfish growing area continue to be sampled under the same protocol, with no changes to the current classifications.

FIGURE 1: SHELLFISH CLASSIFICATION CHART



INTRODUCTION

PURPOSE

This report is part of a series of studies having a dual purpose. The first and primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP) that are established by the Interstate Shellfish Sanitation Conference (ISSC). Reports generated under this program form the basis for classifying shellfish waters for the purpose of harvesting shellfish for human consumption. As such, they provide a critical link in protecting human health.

The second purpose is to provide input to the Integrated Water Quality Monitoring and Assessment Report, which is prepared pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the 305b portion of the Integrated Report, which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries, and ocean waters. The reports provide valuable information for the 305(b) portion of the Integrated Report, which describes the waters that are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution. Similarly, the reports utilize relevant information contained in the 305(b) portion of the Integrated Report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from reports represent two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) portion of the report describes the watershed that drains to that estuary.

The Department participates in a cooperative National Environmental Performance Partnership System (NEPPS) with the USEPA which emphasizes ongoing evaluation of issues associated with environmental regulation, including assessing impacts on water bodies and measuring improvements in various indicators of environmental health. The shellfish growing area reports are intended to provide a brief assessment of the growing area, with particular emphasis on those factors that affect the quantity and quality of the shellfish resource. The shellfish growing area reports provide valuable information on the overall quality of the saline waters in the most downstream sections of each major watershed. In addition, the reports assess the quality of the biological resource and provide a reliable indicator of potential areas of concern and/or areas where additional information is needed to accurately assess watershed dynamics.

HISTORY

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in 1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and continues to meet annually at various locations throughout the United States.

The NSSP *Guide for the Control of Molluscan Shellfish* sets forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. It provides the basis used by the Federal Food and Drug Administration (FDA) in evaluating state shellfish sanitation programs. The five major points on which the state is evaluated by the FDA include:

1. The classification of all actual and potential shellfish growing areas as to their suitability for shellfish harvesting.
2. The control of the harvesting of shellfish from areas that are classified as restricted, prohibited or otherwise closed.
3. The regulation and supervision of shellfish resource recovery programs.
4. The ability to restrict the harvest of shellfish from areas in a public health emergency, and
5. Prevent the sale, shipment or possession of shellfish that cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

FUNCTIONAL AUTHORITY

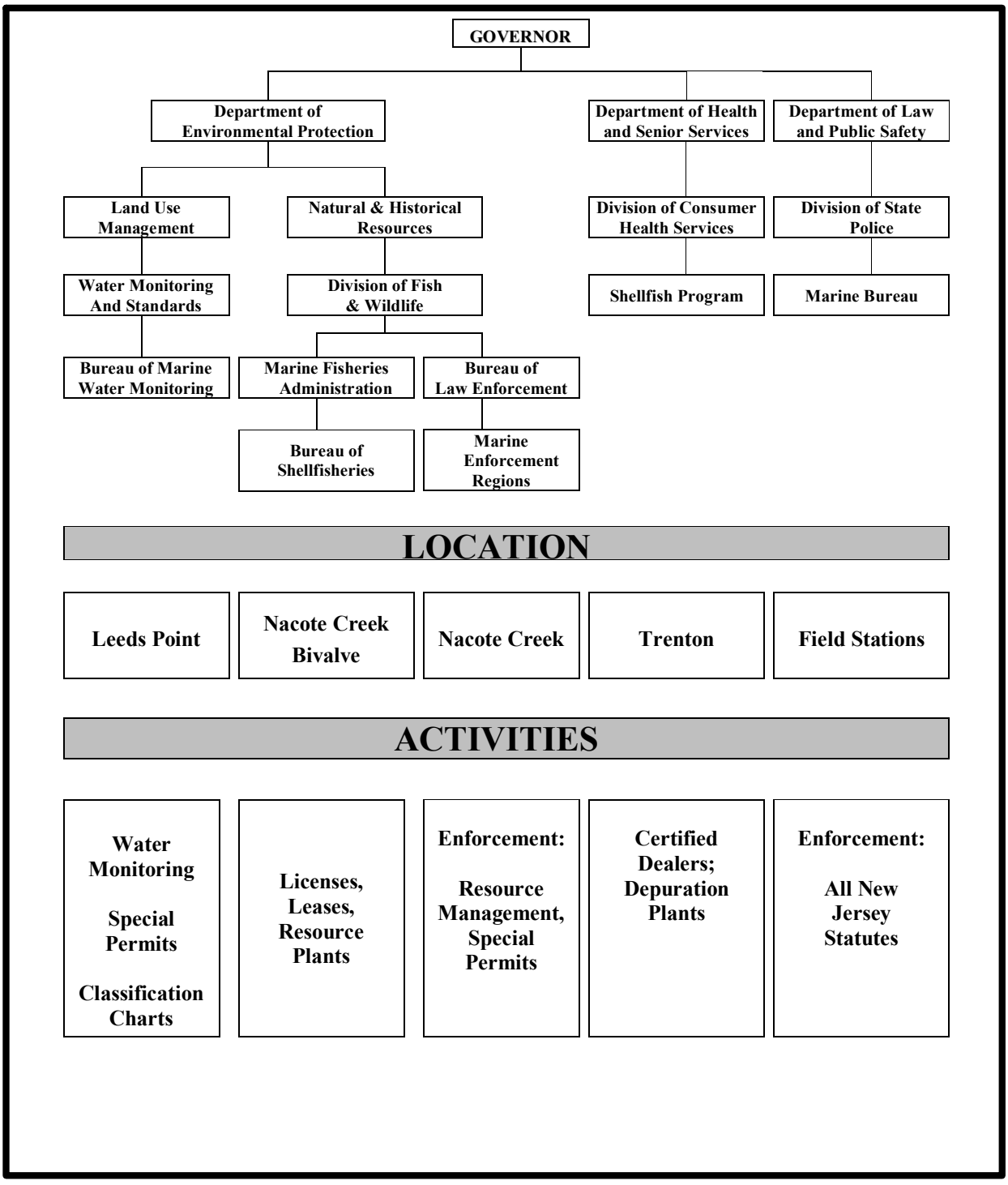
The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and Senior Services and the Department of Law and Public Safety. The Bureau of Marine Water Monitoring (BMWM), under the authority of N.J.S.A. 58:24, classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

The Bureau of Shellfisheries, in the Division of Fish and Wildlife, issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau, in conjunction with the BMWM, administers the Hard Clam Relay Program.

The Bureau of Law Enforcement in the DEP (Division of Fish and Wildlife) and the Division of State Police, in the Department of Law and Public Safety, enforce the provisions of the statutes and rules mentioned above.

The Department of Health and Senior Services is responsible for the certification of wholesale shellfish establishments and, in conjunction with the BMWM, administers the depuration program. See Figure 2.

FIGURE 2: STATE OF NEW JERSEY SHELLFISH AGENCIES



IMPORTANCE OF SANITARY CONTROL OF SHELLFISH

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of diseases to humans. Shellfish-borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via runoff and direct discharges.

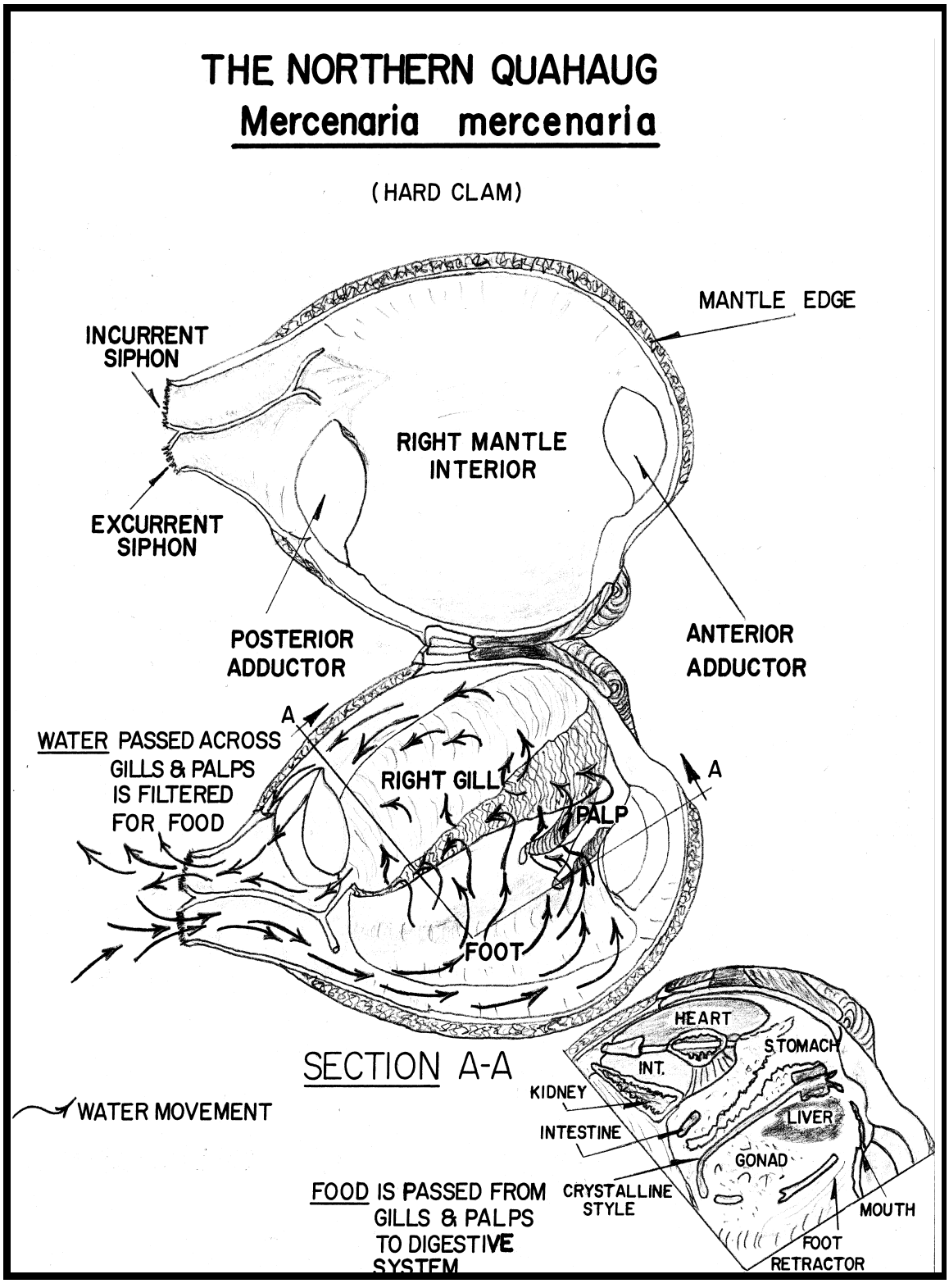
Clams, oysters and mussels pump large quantities of water through their bodies during the normal feeding process (see Figure 3). During this process the shellfish also concentrate microorganisms, which may include pathogenic microbes, and toxic heavy metals/chemicals. It is imperative that a system is in place to reduce the human health risk of consuming shellfish from areas of contamination.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. The principal components of the sanitary survey report include:

1. An evaluation of all actual and potential sources of pollution,
2. An evaluation of the hydrography of the area and
3. An assessment of water quality. Complete intensive sanitary surveys are conducted every 12 years with interim narrative evaluations completed on a three-year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report is initiated prior to its l2 year schedule.

The following narrative constitutes this bureau's assessment of the above mentioned components and determines the current classification of the shellfish growing waters.

FIGURE 3: CROSS-SECTION OF MERCENARIA MERCENARIA



PROFILE

LOCATION

Shellfish Growing Area SE-4 is located in Cape May County, New Jersey. This growing area is situated between Peck Bay and Ludlam Bay. In the north, it begins at the Roosevelt Blvd. Bridge (Rt. 623), ending in the south at Sedge Island by Ludlam Bay, and east at Corson Inlet. The major waterways for this area include Crook Horn Creek, Beach Creek, Corson Sound, Corson Inlet, Middle Thorofare, Main Channel, Flat Creek, and Whale Creek, (see Figure 4). Peck Bay and Ludlam Bay are not included in this shellfish growing area. The location of this shellfish growing area can also be found on the 2005 State of New Jersey Shellfish Growing Water Classification Charts, chart 8.

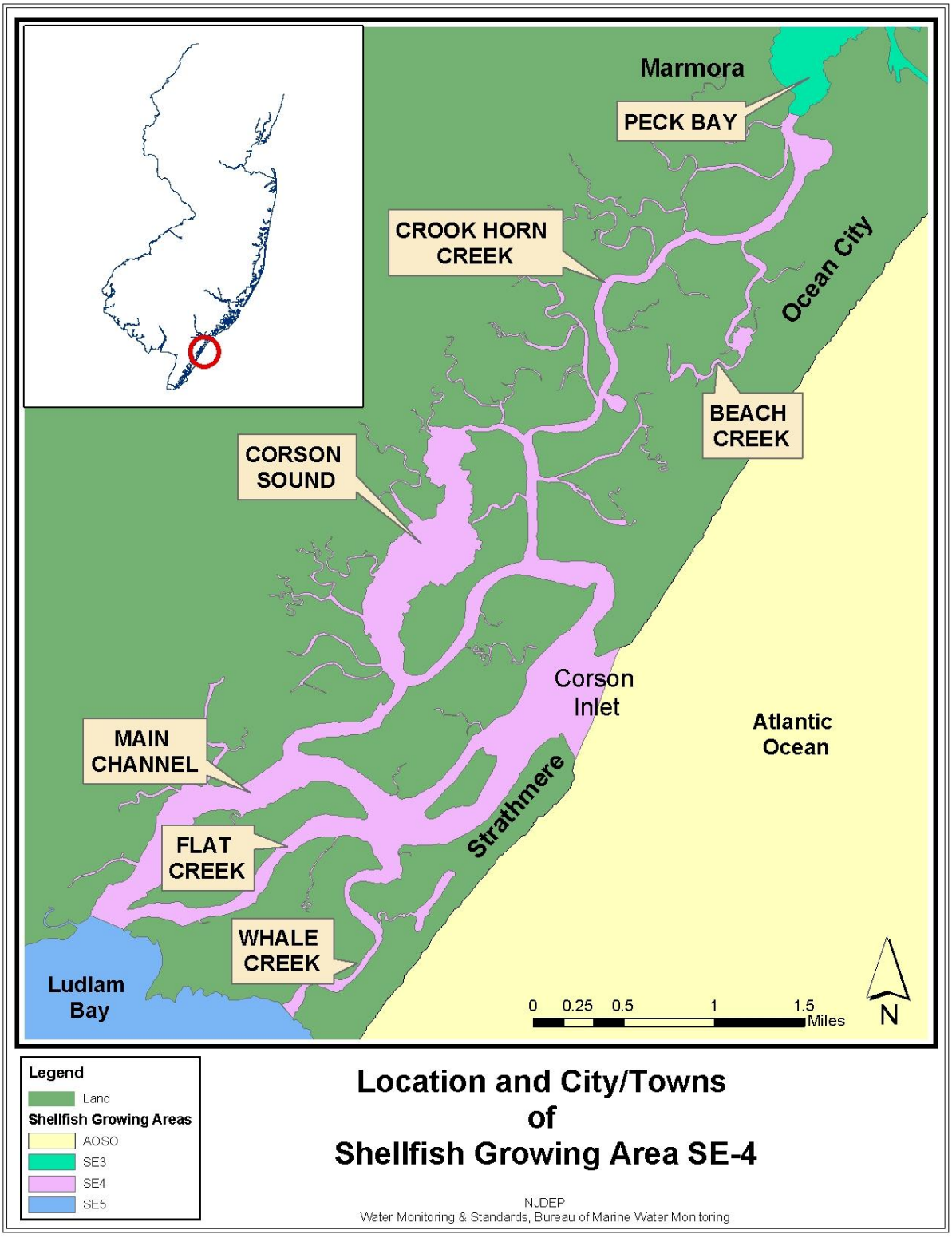
Surrounding this shellfish growing area are several city/towns and they are listed below in Table 1. The information shown in Table 1 represents the demographic profile of the area based on postal zip code. This information was put together by the United States Environmental Protection Agency (EPA) using data collected by the U.S. Census Bureau in 2000.

These municipalities are resort towns and tend to have relatively small year-round populations. However, these numbers increase during the summer season due to tourism.

TABLE 1: POPULATION INFORMATION (SOURCE: EPA & U.S. CENSUS BUREAU)

CITY/TOWN	POSTAL ZIP CODE	POPULATION 2000	POPULATION 1990	POPULATION DENSITY (PER SQ MILE)	LAND AREA (%)	WATER AREA (%)
MARMORA	08223	4,384	4,420	467.28	99.46	0.54
OCEAN CITY	08226	15,378	15,512	1,917.17	35.48	64.52
OCEAN VIEW	08230	5,589	4,443	501.24	95.9	4.1
STRATHMERE	08248	175	163	69.46	41.61	58.39

FIGURE 4: LOCATION AND CITY/TOWNS OF SHELLFISH GROWING AREA SE-4



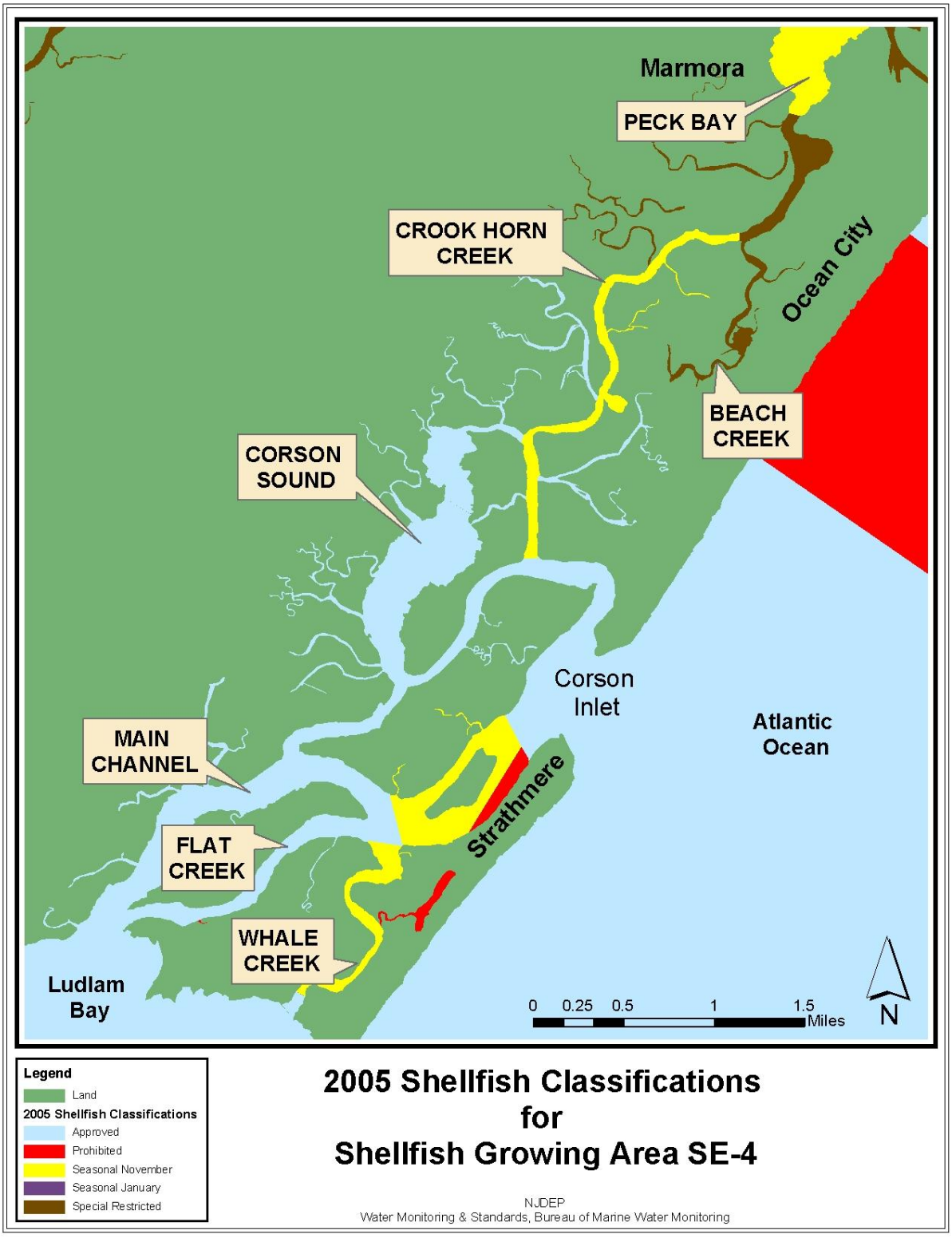
DESCRIPTION

The current shellfish classifications for Shellfish Growing Area SE-4 are *Approved* (year-round), *Seasonally Approved (November to April)*, *Special Restricted*, and *Prohibited*. There are approximately 1,408 acres in this growing area, of which, 998 acres are classified as *Approved*, 259 acres are classified as *Seasonal*, 116 acres are classified as *Special Restricted*, and 35 acres are classified as *Prohibited*.

Areas classified as *Approved year-round*, means shellfish harvesting is permitted year-round. *Prohibited* area means no harvesting of shellfish at any time of the year. The *Seasonally Approved area* means harvesting is only permitted within a certain time frame. There are two categories of *Seasonally Approved*, *Seasonally Approved (November to April)* and *Seasonally Approved (January to April)*. There is no classification of *Seasonally Approved (January to April)* in Shellfish Growing Area SE-4. However, there are several regions in this growing area that are classified as *Seasonally Approved (November to April),* which means harvesting is only permitted between the 1st of November through the 30th of April. Shellfish harvested from *Special Restricted* areas are required to undergo a purification process before they can be sold commercially.

The *Seasonally Approved (November to April)* areas can be found in Whale Creek, Strathmere Bay, and the southern portion of Crook Horn Creek. Areas classified as *Special Restricted* are Beach Creek, Ben Elders Creek, Upland Creek, Run Creek, and the northern portion of Crook Horn Creek starting at the mouth of Beach Creek proceeding north toward Peck Bay. The *Prohibited* areas are in Main Channel by Strathmere and the unnamed creek located by Whale Creek. A large percentage of this growing area is classified as *Approved* year-round. All of Corson Sound, Edward Creek, Weakfish Creek, Middle Thorofare, Main Channel, Mill Creek, Marshalls Creek, Flat Creek, and Corson Inlet are classified as *Approved year-round* (see Figure 5). The water classifications for this shellfish growing area can also be found on chart 8 of the "2005 State of New Jersey Shellfish Growing Water Classification Charts".

FIGURE 5: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA SE-4



HISTORY OF SHELLFISH GROWING AREA

All of Crook Horn Creek, Beach Creek, and Whale Creek were once classified as *Prohibited*. In the 1970's, Strathmere Bay was classified as *Seasonally Approved (January to April)*. Then in 1980, a small area of Main Channel as downgraded to *Prohibited* due to septic systems. The condemned area acted as a dilution buffer for contaminants entering into open water via stormwater outfalls and/or septic systems. To this day, this area is still classified as *Prohibited*. Since then, the water quality for this shellfish growing area has improved tremendously. By 1983, all of Whale Creek and the Seasonally Approved section of Main Channel were upgraded to Seasonally Approved (November to April). This revision resulted in the reclassification of approximately 55 acres. As of 2005, there are more areas open for shellfish harvesting than there were back in the 1980's. Even though the water quality for this area has improved, it is still impacted by storm water discharges, boating activities, septic systems, and illegal dumping.

METHODS

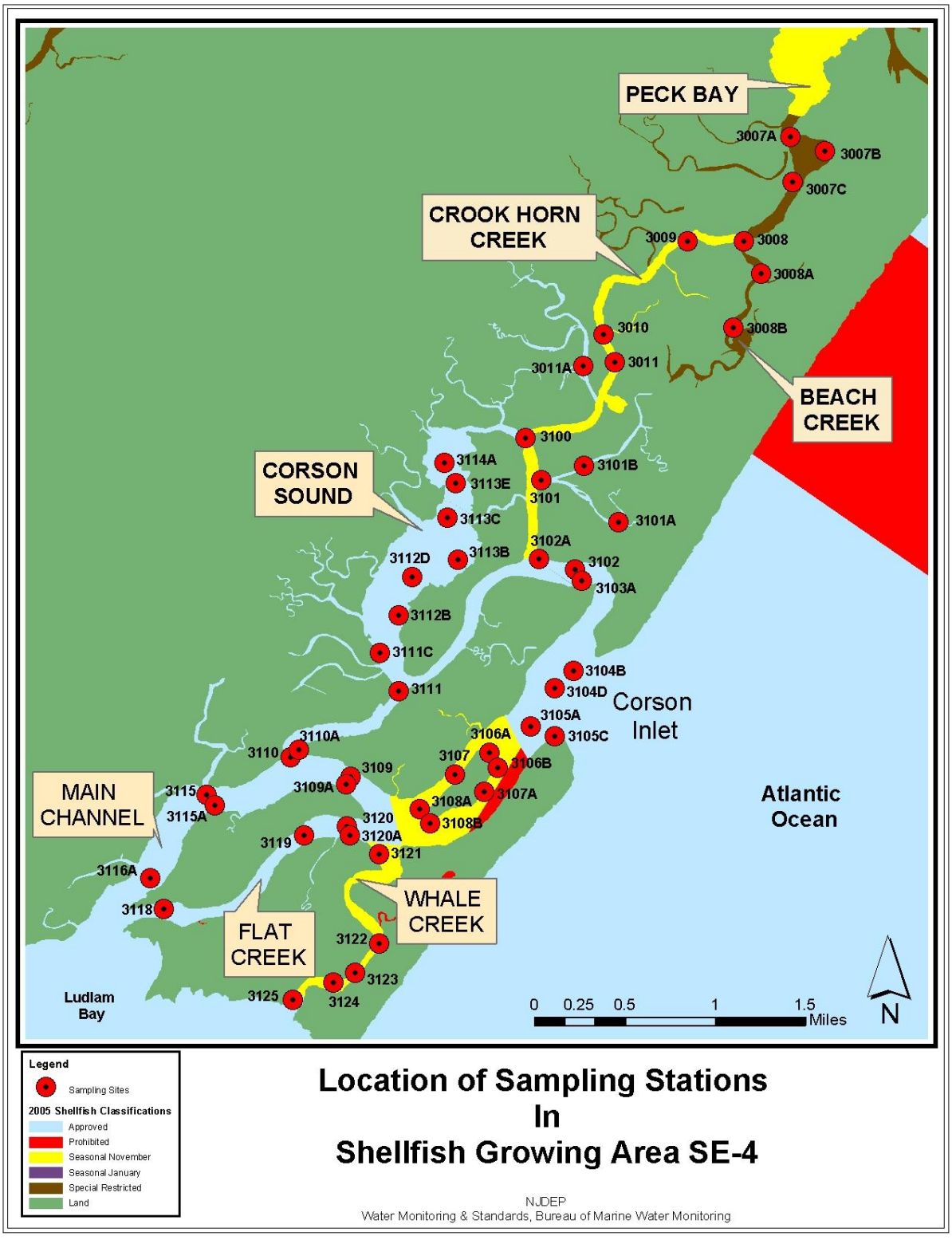
Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1992).

Approximately 1,978 water samples were collected for total coliform bacteria between 2000 and 2004 and analyzed by the three tube MPN method according to APHA (1970). Figure 6 shows the Shellfish Growing Water Quality monitoring stations in the SE-4. Approximately 51 stations are monitored during each year.

Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish,* 1999 Revision.

Data management and analysis was accomplished using database applications developed for the Bureau. Mapping of pollution data was performed with the Geographic Information System (GIS:ARCVIEW®).

FIGURE 6: SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-4



BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved, Special Restricted,* or *Prohibited*. Criteria for bacterial acceptability of shellfish growing waters are provided in NSSP *Guide for the Control of Molluscan Shellfish,* 1999 Revision.

SAMPLING STRATEGY

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition Strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide and rainfall, but could be from a point source of pollution or variation could occur during a specific time of the year.

The Systematic Random Sampling strategy requires that a random sampling plan be in place before field sampling begins. This strategy can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to the database to obtain a sample size of 30 for statistical analysis.

Shellfish Growing Area SE-4 is sampled under the Systematic Random Sampling strategy as described above.

NSSP CRITERIA

Each shellfish-producing state is directed to adopt either the total coliform criterion, or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each sampling station. These data are viewed as adjunct information and are not directly used for classification.

The criteria were developed to ensure that shellfish harvested from the designated waters would be free of pathogenic (disease-producing) bacteria. Each classification criterion is composed of a measure of the statistical 'central tendency' (geometric mean) and the relative variability of the data set. For the Adverse Pollution Condition sampling strategy, variability is expressed as the percentage that exceeds the variability criteria (see Table 2). For the Systematic Random Sampling Strategy, variability is expressed as the 90^{th} percentile (see Table 3).

Areas to be approved under the *Seasonal* classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

TABLE 2: CRITERIA FOR ADVERSE POLLUTION CONDITION SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	**No more than 10% of samples can exceed** (MPN/100 mL)	**Geometric mean** (MPN/100 mL)	**No more than 10% of samples can exceed** (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

TABLE 3: CRITERIA FOR SYSTEMATIC RANDOM SAMPLING STRATEGY

	Total Coliform Criteria		Fecal Coliform Criteria	
	Geometric mean (MPN/100 mL)	**Estimated 90th percentile** (MPN/100 mL)	**Geometric mean** (MPN/100 mL)	**Estimated 90th percentile** (MPN/100 mL)
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

A shoreline survey was conducted in March of 2005. There were no major developments adjacent to Shellfish Growing Area SE-4. However, there were several minor construction projects underway in Ocean City and Strathmere, most of which were home renovations. The homes in Ocean City are connected onto the city sewer system, which is operated by the Ocean City Wastewater Treatment Facility. This facility is located on 45th and West Avenue in Ocean City (see Figure 7). The treated effluent is discharged into the Atlantic Ocean, which leaves very little or no impact to this shellfish growing area.

Private septic systems still exist in Strathmere. Due to the high water table for this area, newer homes have septic systems built above ground (see Figure 8). In older homes, septic systems are still located underground, probably beneath the homes. There is always the concern that these septic systems will leak into Main Channel and into shellfish growing waters. For this reason, portions of Main Channel and Whale Creek are classified as *Prohibited* and *Seasonal*, respectively.

There are not many marinas found in this area. The Blue Water Marina is located in the north, by the Roosevelt Bridge (Rt. 623) in Ocean City (see Figure 9). This is the largest marina found in this shellfish growing area. The Deauville Inn is a restaurant that has about 40 transient slips, most of which are removed from the water during the winter season (see Figure 10). There is also a boat ramp by the Corson's Inlet State Park and several smaller marinas along Whale Creek, most of which have less than 20 slips and can only accommodate boats less than 24 feet.

This shellfish growing area is surrounded by wetland and tidal marshes. Therefore, it provides a good nesting and breeding ground for birds. In certain areas, hundreds of birds can be found sitting in shallow waters (see Figure 11).

FIGURE 7: OCEAN CITY WASTEWATER TREATMENT FACILITY

FIGURE 8: ABOVE GROUND SEPTIC SYSTEM IN STRATHMERE

FIGURE 9: BLUE WATER MARINA

FIGURE 10: DEAUVILLE INN

FIGURE 11: WILDLIFE OBSERVATION

LAND USE

This shellfish growing area is part of what is known as the Cape May Atlantic Coast Complex, which is defined as a beach/back barrier lagoon system that extends for 27 miles starting from Peck Bay to Cape May. This part of the New Jersey back barrier system is characterized by networks of salt marsh islands and small-protected shallow bays, connected by a network of channels and tidal creeks The following bays are part of this system: Corson Sound, Ludlam Bay, Townsend Sound, Stites Sound, Great Sound, Jenkins Sound, Grassy Sound, Richardson Sound, Sunset Lake, Jarvis Sound, and Cape May Harbor (US Fish & Wildlife Service's, 1997).

The barrier islands along the Atlantic Coast from Great Egg Harbor Inlet to Cape May are generally developed, with the exception of some beach front and small areas near the inlet that remain undeveloped. Corson Inlet is one of these areas. Corsons Inlet State Park was established in 1969 to help preserve one of the last undeveloped tracts of land along the state oceanfront. The NJDEP Division of Parks and Forestry manages Corsons Inlet State Park, Strathmere Natural Area, and Great Sound State Park. These areas are also designated as a protected beach unit pursuant to the federal Coastal Barrier Resources Act (US Fish & Wildlife Service's, 1997).

This shellfish growing area is enclosed by wetlands, which can act as a barrier from the surrounding population center (see Figure 12 & 13). Wetlands act as a purifier against pollutants as well as provide great volumes of food that attract many animal species. Dead plant leaves and stems break down in the water to form small particles of organic material. This enriched material feeds many small aquatic insects, shellfish, and small fish that are food for larger predatory fish, reptiles, amphibians, birds, and mammals. Many species rely on wetlands for food, water, and shelter, especially during migration and breeding (EPA, 2005).

FIGURE 12: LAND USE PATTERNS

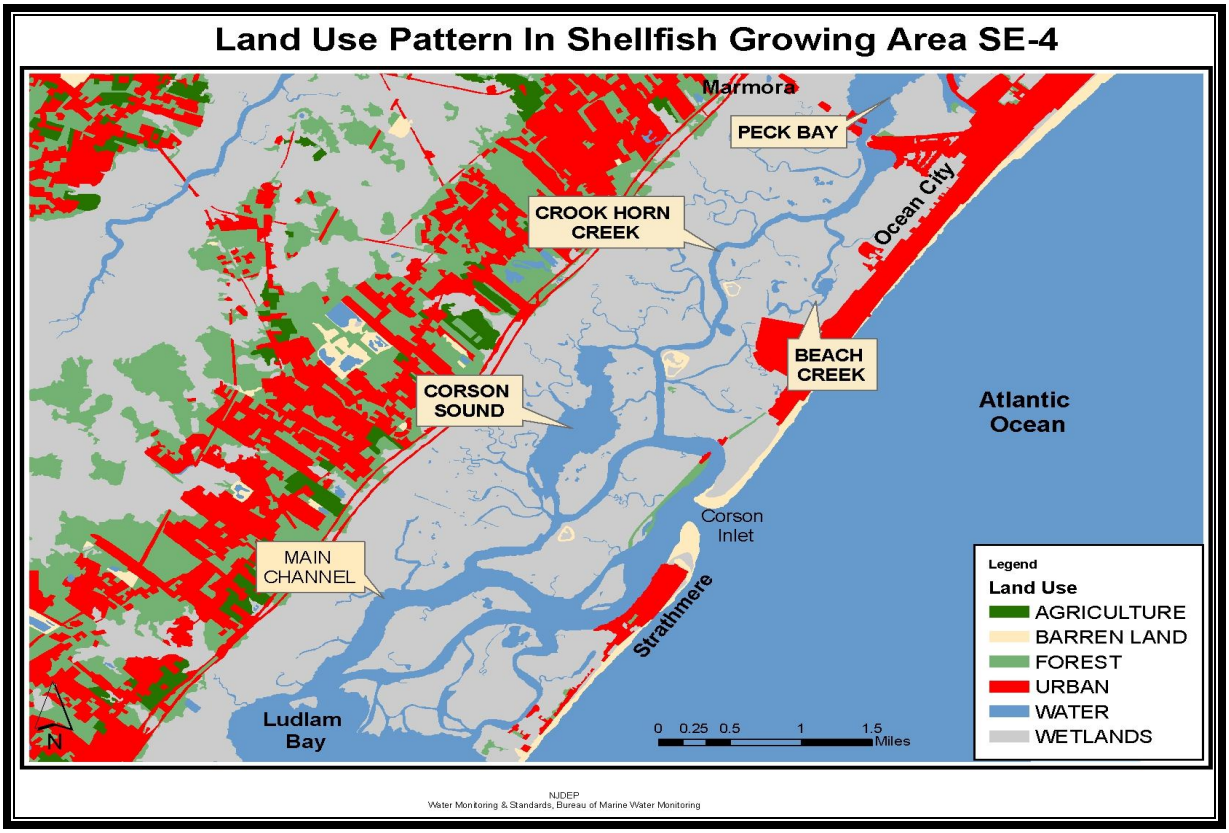


FIGURE 13: WETLAND SURROUNDING SHELLFISH GROWING AREA SE-4

EVALUATION OF BIOLOGICAL RESOURCES

Several studies were conducted by the New Jersey Department of Environmental Protection (NJDEP) between 1968 through 1970 at Corson Inlet. Numerous species were found in this area including bay anchovy (Anchoa mitchilli), American eel (Anguilla rostrata), Atlantic silversides (Menidia menidia), Atlantic menhaden, winter flounder (Pleuronectes americanus), American sandlance (Ammodytes americanus), sculpin (Myoxcephalus aenaeus), cunner (Tautogolabrus adspersus), and northern pipefish (Syngnathus fuscus). The studies indicated that this area provides a good nesting, nursery, and spawning habitat for several species described above (US Fish & Wildlife Service, 1997).

Corson's Inlet State Park and Strathmere Natural Area are one of the few areas left in the state that still consists of undeveloped beachfront and undisturbed sand dune. There are approximately 448 acres of natural habitat, and it is home to many species, such as shorebirds and waterfowls. These areas also serve as a protective nesting site for some of our endangered species, such as the Piping Plover, Least Tern, and Black Skimmers (see Figure 14).

FIGURE 14: LOCATION OF OBSERVED WILDLIFE HABITAT IN SHELLFISH AREA SE-4

IDENTIFICATION AND EVALUATION OF POLLUTION SOURCES

The discharge of pollutant from a point source is authorized under New Jersey Pollutant Elimination System (NJPDES), and the regulations are found at N.J.A.C. 7:14A. The main purpose of the NJPDES program is to ensure proper treatment and discharges of wastewater. By doing so, the permit limits the amount or concentration of pollutants that can be discharged into ground water, streams, rivers, and the ocean. Facilities regulated under this program include mines, schools, hospitals, large corporate office buildings, industrial manufacturing facilities, campgrounds, mobile home parks, food processor, potable water treatment plants, sewage treatment plants, or any dischargers that may have the potential to impact water quality (NJDEP, Division of Water Quality).

There are several types of discharges, for this report it will be separated into two categories, Direct and Indirect Discharges. See below for further information.

DIRECT DISCHARGES

Direct discharges have the greatest potential to impact water quality. Examples of direct discharges are surface water discharge, stormwater discharge, and marina.

Surface Water Discharges

A surface water discharge involves the release of treated effluent from various municipal and industrial facilities directly into a river, stream, or the ocean. As of 2001, there were 796 permits issued under the NJPDES program for surface water discharge, of which, 271 permits were for municipal wastewater facilities and 525 permits were for industrial facilities.

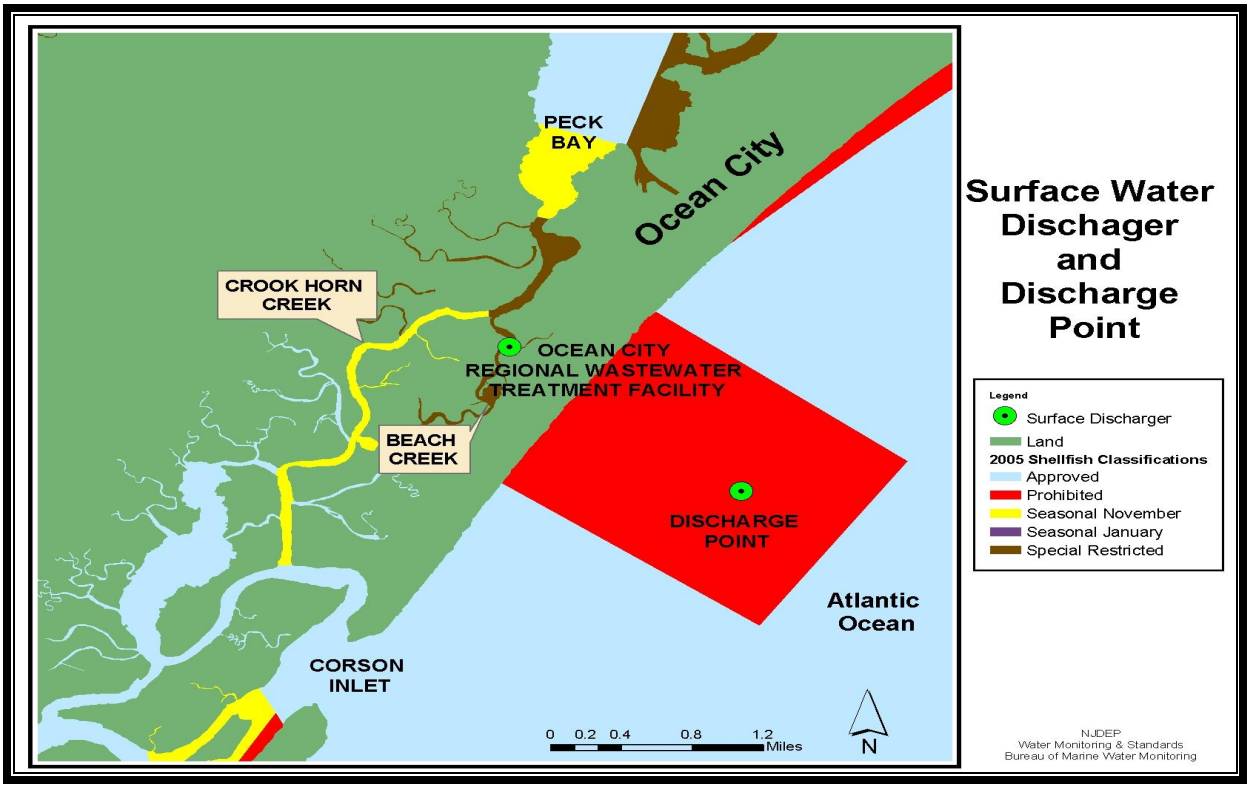
There is only one surface discharger found in this shellfish growing area (See Table 4). The Ocean City Regional Wastewater Treatment Facility is located in Ocean City, which provides service only to Ocean City (see Figure 15). The treated effluents are discharged to the Atlantic Ocean (see Figure 16).

TABLE 4: SURFACE DISCHARGERS-FACILITY INFORMATION (SOURCE: NJDEP)

NJPDES ID	Name	Address	Description	Discharge Type
NJ0035343	Ocean City Regional Wastewater Treatment Facility	45th Street & Simpson Ave.	Treatment Facility	Surface

FIGURE 15: OCEAN CITY REGIONAL WASTEWATER TREATMENT FACILITY (SOURCE: HTTP://WWW.CMCMUA.COM/)

FIGURE 16: OCEAN CITY REGIONAL WASTEWATER DISCHARGE POINT

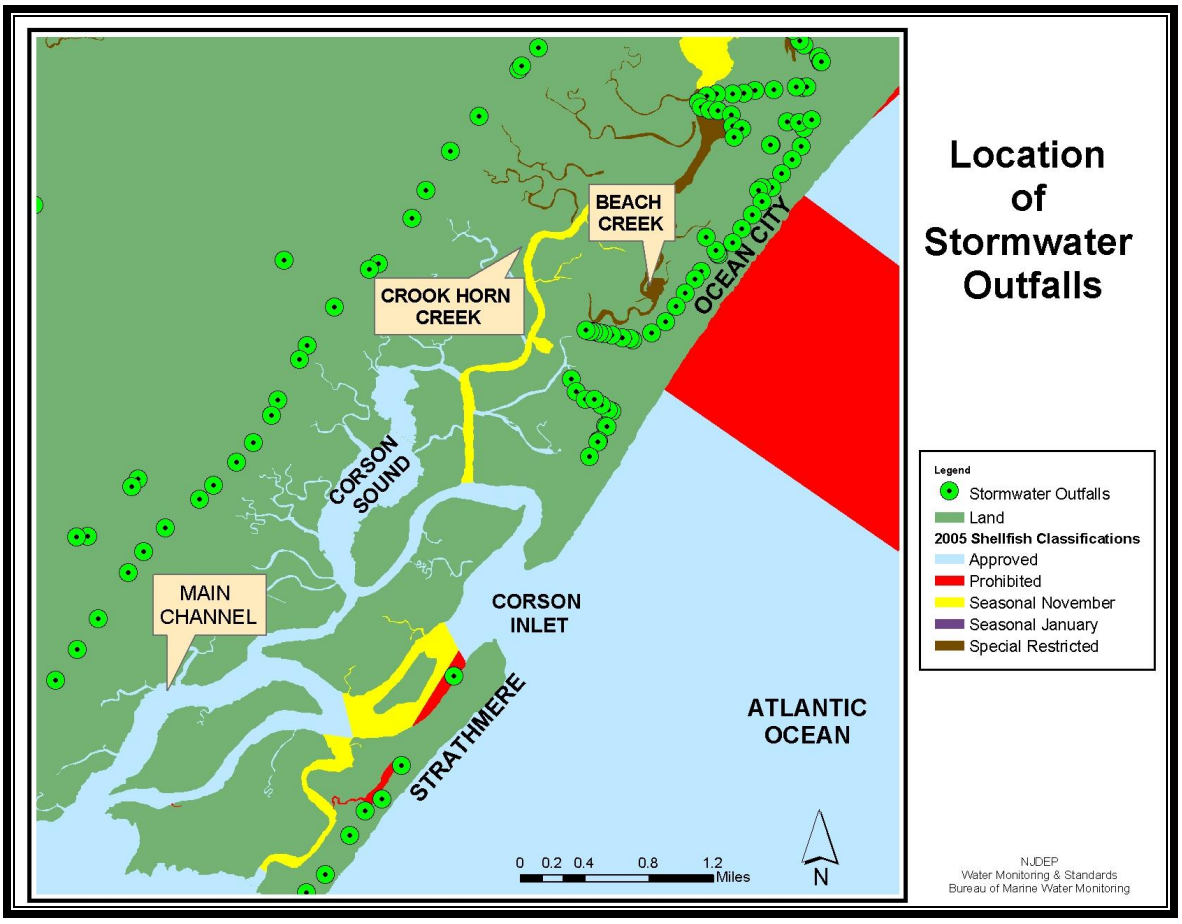


Stormwater Discharge

A stormwater discharge is commonly known as "run off"; it could be anything from rain, snow, litter or industrial materials that can be exposed to stormwater. These materials do not normally end up in a treatment facility, but, rather, flow directly into storm drains that will be eventually released into nearby a water body via a stormwater outfall. The types of pollutants that can enter into storm drain systems include toxic chemicals, oil and grease, plastics, sediment, residential trash, and animal feces. All of these and many other substances can be a potential threat to our water resources.

As of 2001, there were 2,056 NJPDES permits issued for stormwater discharges, 209 individual, and 1847 general, (NJDEP, 2001). Figure 17 shows the locations of stormwater outfalls situated within this shellfish growing area. There are numerous stormwater outfalls, especially in Ocean City.

FIGURE 17: LOCATION OF STORMWATER OUTFALLS



Marina

Marina facilities have the potential to affect the suitability of shellfish growing areas for the harvest of shellfish. The biological and chemical contamination associated with marina facilities may be of public health significance. New Jersey defines a marina as "any structure (docks, piers, bulkheads, floating docks, etc.) that supports five or more boats, built on or near the water, which is utilized for docking, storing, or otherwise mooring vessels and usually but not necessarily provides services to vessels such as repairing, fueling, security or other related activities". The confines of the marina are designated as *Prohibited* for the harvest of shellfish. Adjacent waters are classified using a dilution analysis formula.

It is recognized by the NSSP *Guide for the Control of Molluscan Shellfish,* 1997, that there are significant regional differences in all factors that affect marina pollutant loading. The manual, therefore, allows each state latitude in applying specified occupancy and discharge rates. The NSSP guidelines assume the worst case scenario for each factor.

EQUATION 1 :MARINA BUFFER EQUATION. (ADAPTED FROM FDA. 1989):

$$BufferRadius(ft) = \sqrt{\frac{2x10^{9}(FC/person/day)x2(person/boat)x[(.25slips \geq 24') + (0.065 \times slips < 24')]x2}{140000(FC/M^{3})xdepth(ft)x0.3048(M/ft)x\pi x2(tides/day)}}x3.28(ft/M)$$

Explanation of terms in equation:

Fecal coliform per person per day:	2 x 10^{9}
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste
Angle of shoreline:	180^{o}, which results in factor of 2
Number of tides per day:	2
Depth in meters:	depth in feet x conversion factor
Water quality to be achieved:	140000 FC/meter ^{3}
Convert meters to feet:	3.28

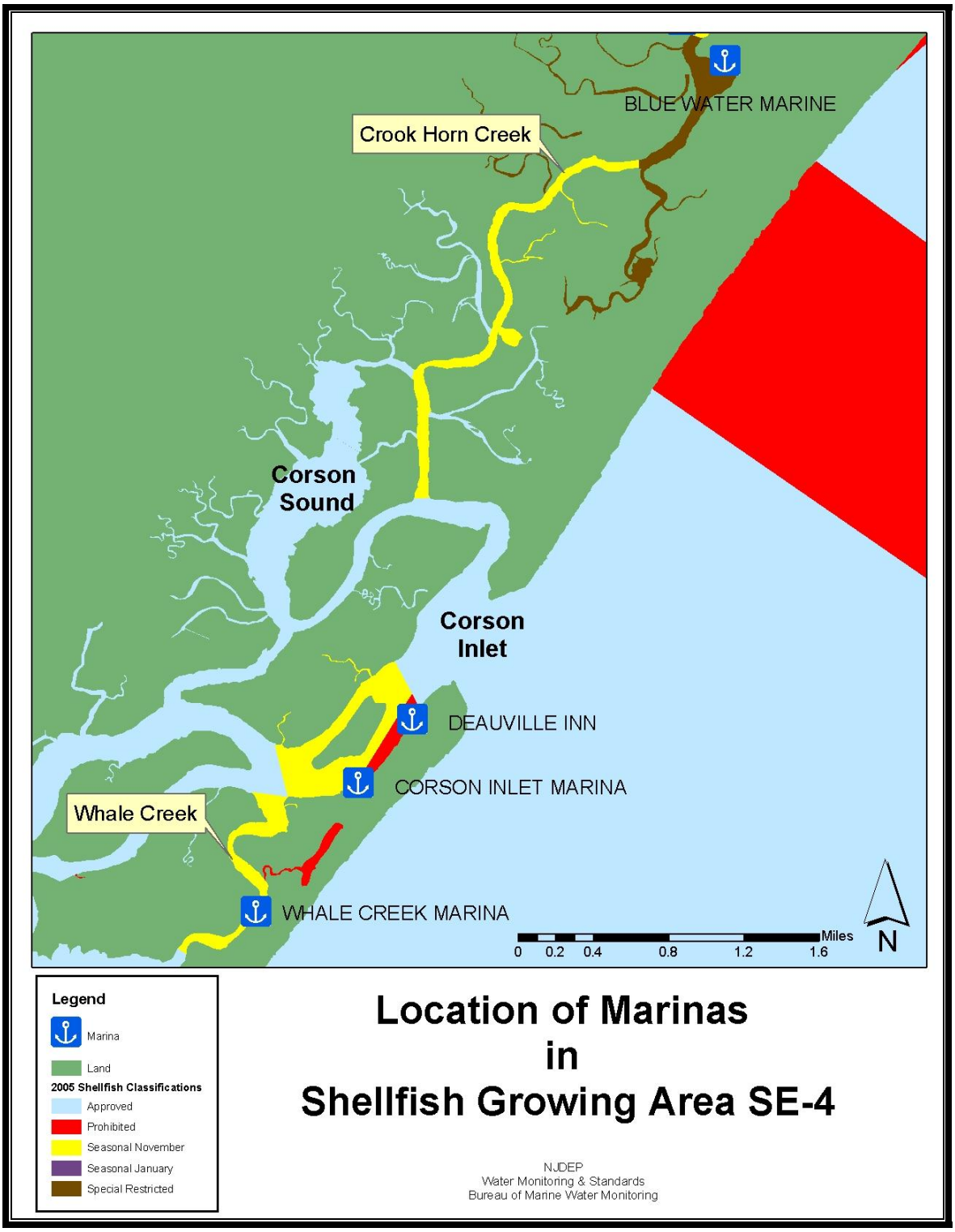
Marina buffer zones may be calculated using the formula above, or may be determined using a dilution analysis computer program developed by the State of Virginia and the USFDA. The formula above considers only dilution and occupancy rates. The computer program, which is used for complex configurations where the formula is unlikely to provide the needed accuracy, also considers tidal exchange and bacterial die-off. There are four marinas found in the SE-4 area. See Table 5, Figure 18, and Figure 19 for marina information and locations. The waters surrounding these marinas are classified as *Prohibited*; depending on the size of the marina and the water quality, waters immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally Approved* (no harvest during summer months when the marina is active). Marina buffer zones were calculated using the method described above. The size of each buffer zone is shown in Table 5.

TABLE 5: MARINA IN SHELLFISH GROWING AREA SE-4

Name	Location	Total Slips	Slips > 24 ft	Slips < 24ft	Depth (ft)	Buffer (radius; feet)
Blue Water Marina	Ocean City	156	78	78	5	1256
Deauville Inn	Strathmere	40	2	38	5	437
Corson Inlet Marina	Strathmere	15	0	15	5	250
Whale Creek Marina	Strathmere	20	0	20	5	289

FIGURE 18: WHALE CREEK MARINA

FIGURE 19: LOCATION OF THE MARINA IN SHELLFISH GROWING AREA SE-4



INDIRECT DISCHARGES

An indirect discharge involves any kind of discharge that can inadvertently affect shellfish growing waters. Examples of indirect discharges are ground water discharge, known contaminated sites, and landfills. As of 2001, there were 892 NJPDES permits issued in New Jersey to both municipal and industrial facilities, including landfills for ground water discharges. Known contaminated sites and solid waste landfills can be found throughout the state; however, only few remain active (NJDEP, Division of Water Quality).

Ground Water Discharges

The sources of indirect ground water discharge into this shellfish growing area include industrial manufacturing facilities, campgrounds, schools, commercial businesses, etc. There are several ground water dischargers found adjacent to this shellfish growing area (see Figure 20). These facilities are required to obtain a NJPDES ground water permit, which limits the amount of waste they can discharge into the ground. By regulating the amount of waste a facility can discharge, the state can monitor how much waste is injected into the ground, thus ensuring that our ground water is protected (NJDEP, Division of Water Quality).

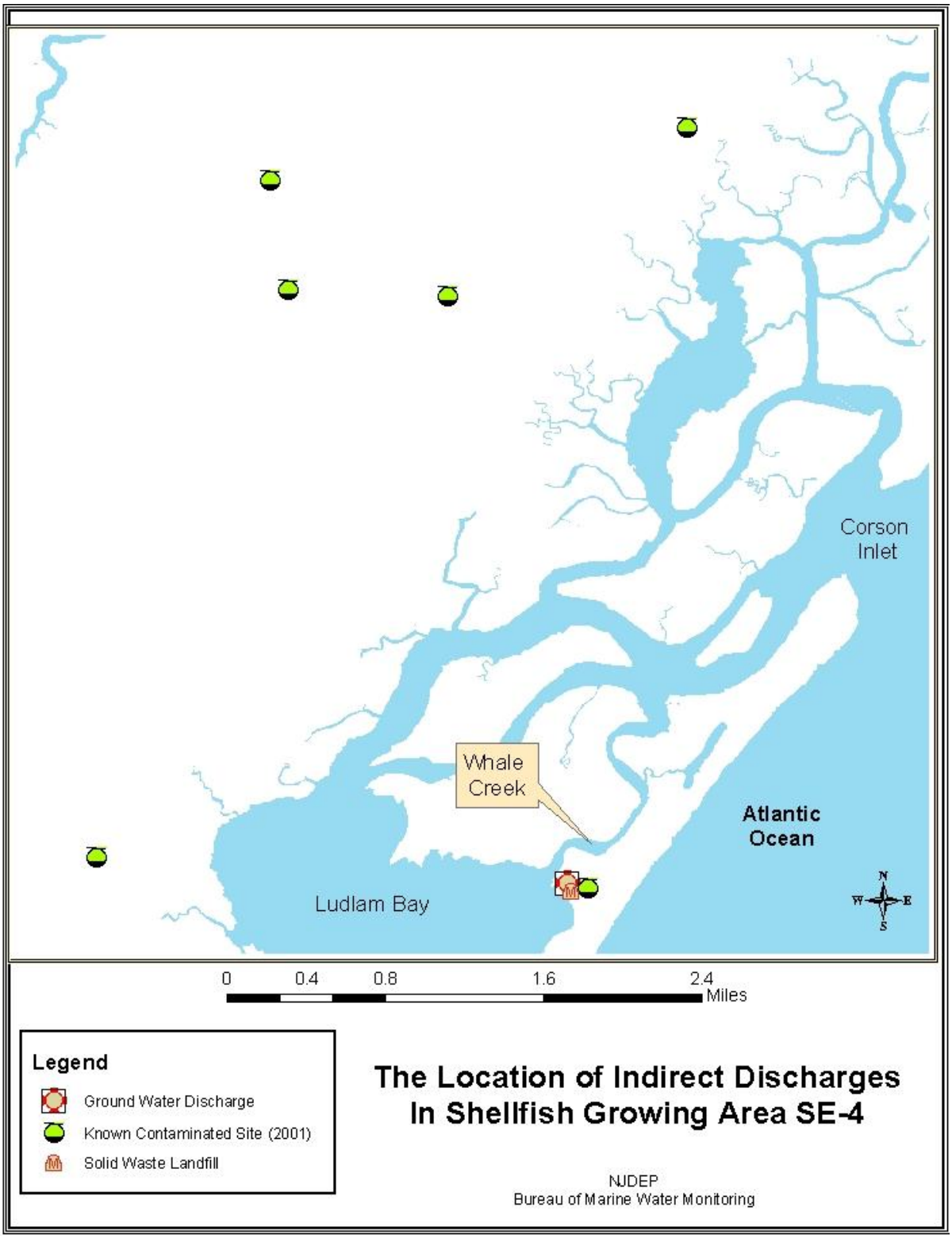
Known Contaminated Sites

There are several known contaminated sites adjacent to shellfish growing area SE-4 (see Figure 20). The highest concentrations of these known contaminated sites are located in Upper Township. The primary causes of these known contaminated sites are from leaking underground storage tanks. Any underground discharges are absorbed by the soil surrounding the tank, which leaves very little impact to the surrounding water. Most of these sites have either been closed or are currently going through review by the NJDEP Site Remediation Program.

Landfills

There is one solid waste landfill located in close proximity to this shellfish growing area (see Figure 20). The Sea Isle City landfill is located on 5th St & Landis Avenue. This facility is no longer operating and had been closed since the early 1980's.

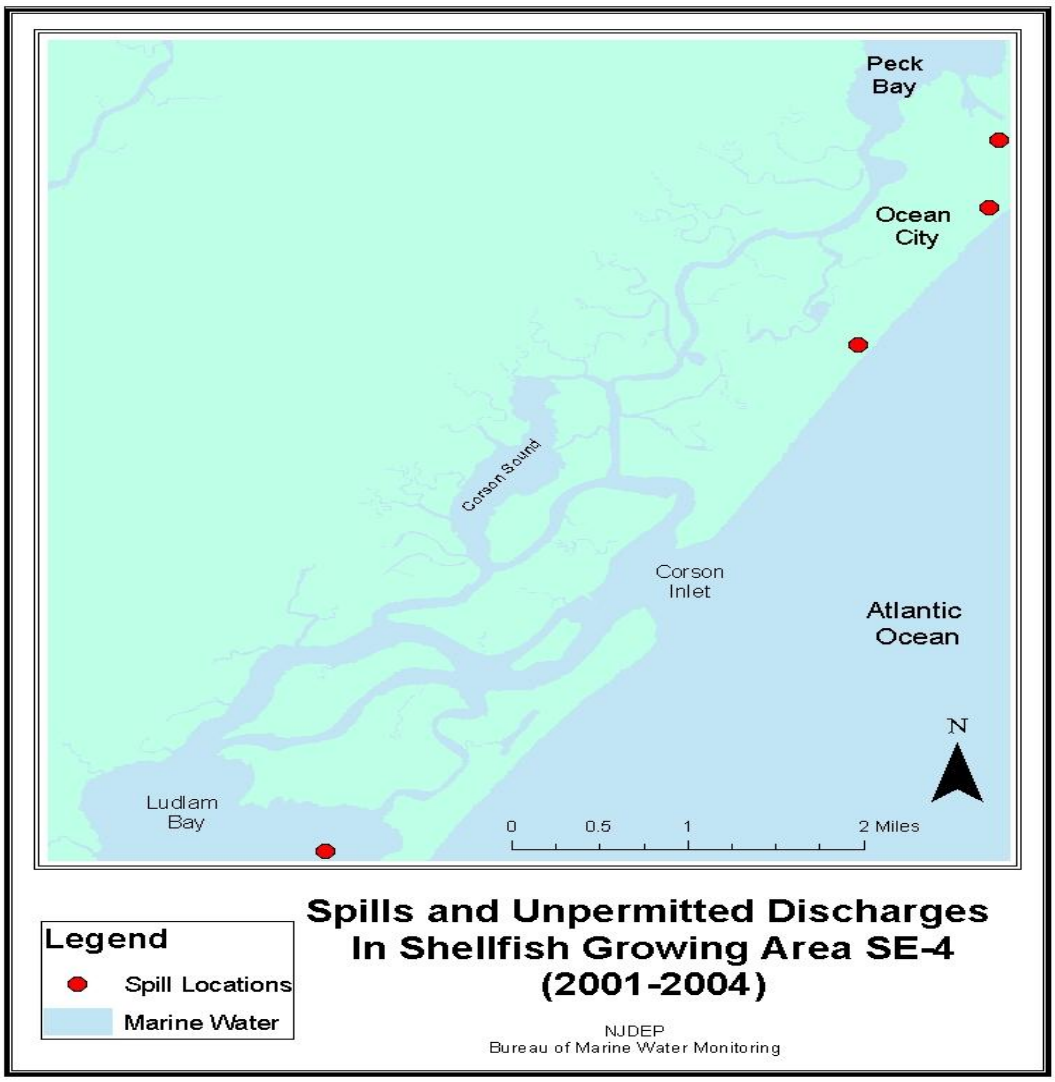
FIGURE 20: LOCATION OF INDIRECT DISCHARGERS IN SHELLFISH GROWING AREA SE-4



SPILLS OR OTHER UNPERMITTED DISCHARGE

Spills or unpermitted discharges are reported throughout New Jersey. Between 2001 and 2004, there were approximately four spills reported to the Bureau of Marine Water Monitoring that were in close proximity to Shellfish Growing Area SE-4 (see Figure 21). The type of effluent that was discharged was raw sewage. The amount of raw sewage discharged was reported to be minimal and all discharges were terminated within 24 hours. None of the spills reported resulted in the closure of shellfish waters.

FIGURE 21: SPILLS OR OTHER UNPERMITTED DISCHARGES IN SHELLFISH GROWING AREA SE-4



HYDROGRAPHY AND METEOROLOGY

New Jersey is located about halfway between the Equator and the North Pole. Because of it geographic location, the state is influenced by wet, dry, hot, and cold air streams. Temperature differences between the northern and southern parts of the state are greatest in the winter and least in the summer. The average annual precipitation ranges from about 40 inches along the southeast coast to 51 inches in the north-central parts of the state. Snow falls from October to April in the highlands and from November to April in southern counties. (Ludlam, 1983).

In the coastal zone, the ocean temperature tends to be warmer than the land surface during the autumn and early winter months. Being adjacent to the Atlantic Ocean, the ocean breezes keep the temperatures along the coast cooler during the spring and summer seasons. The typical summer storms are localized storms associated with thunderstorms. Winter storms are frequently associated with northeasters, which occur most often between October and April. These storms can spread several hundreds of miles offshore, bringing strong winds and heavy rains. Hurricanes and tropical storms are a special concern along the coast. They can contribute a significant amount of the precipitation and cause beach erosion. (Ludlam, 1983)

Precipitation and temperature inputs for this area are shown in Table 7. The primary weather station is 311, which is located at the Atlantic City International Airport. Table 6 consists of precipitation data recorded on the day of sampling plus two days before and temperature on the day of sampling. Figures 22 and 23 display the pattern of precipitation and temperature between 2000 to 2004, respectively. The graph was created using the data recorded by the National Weather Service Center. *Note: Figures 22 & 23 were created using the data recorded by the National Weather Service Center for Atlantic City, NJ.*

FIGURE 22: PRECIPITATION TRENDS FOR ATLANTIC CITY, NEW JERSEY (2000-2004)

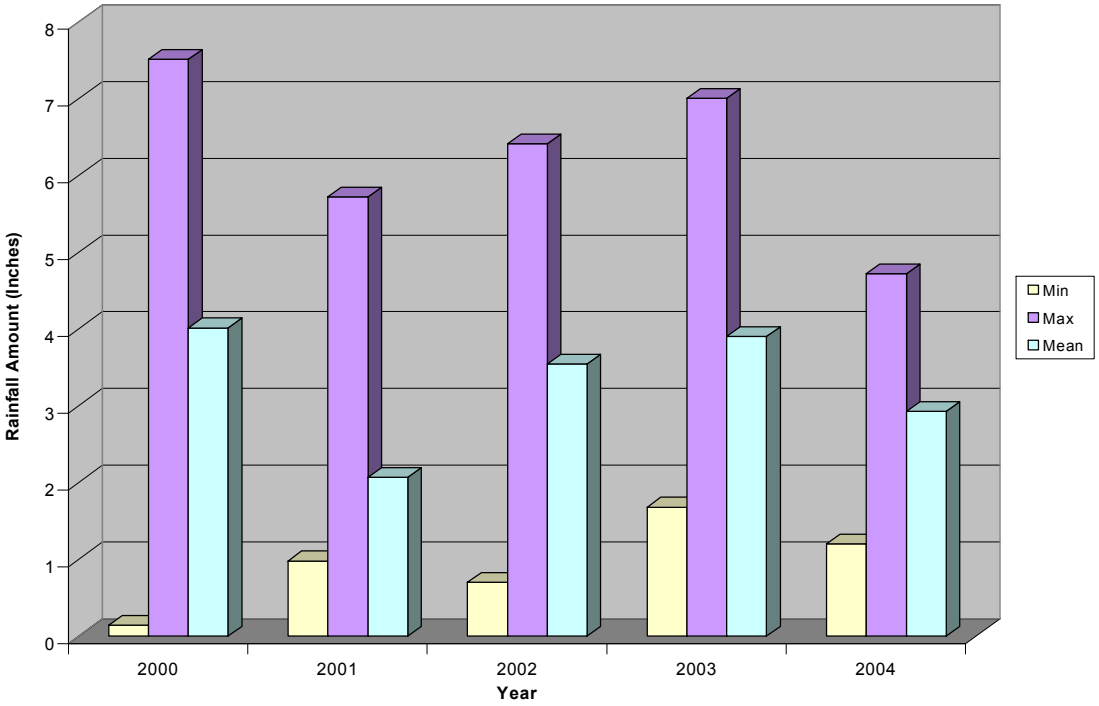


FIGURE 23: TEMPERATURE TRENDS FOR ATLANTIC CITY, NEW JERSEY (2000-2004)

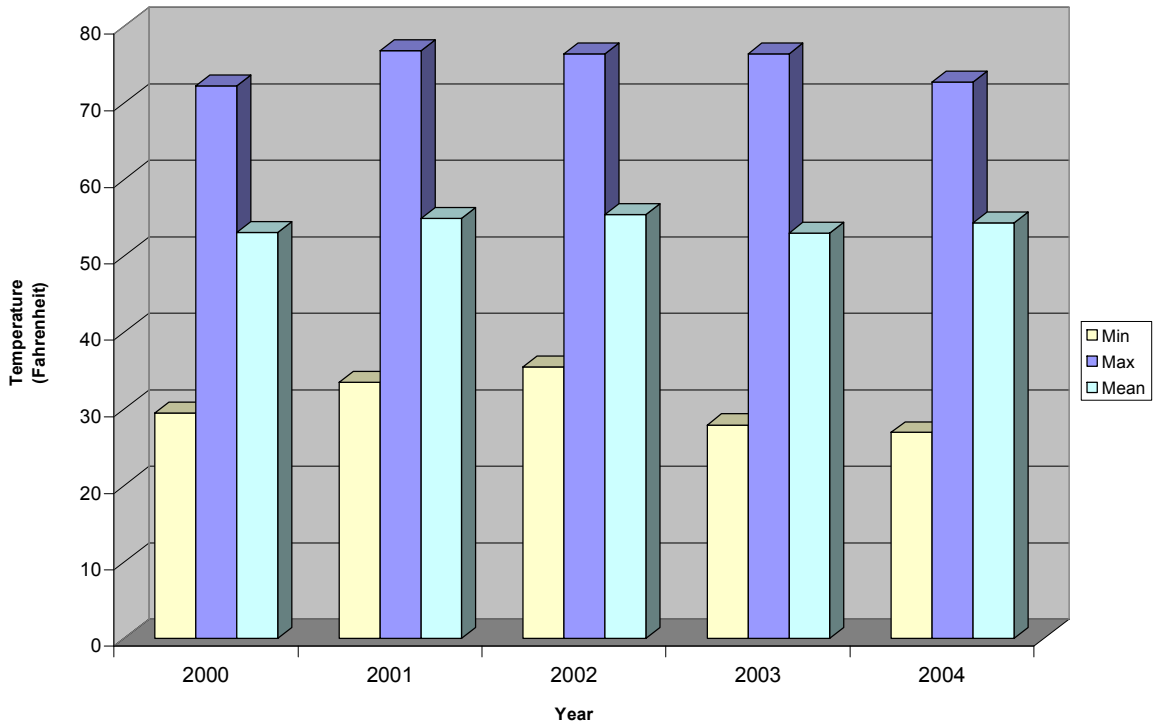


TABLE 6: CLIMATOLOGICAL DATA
Rainfall Recorded at NOAA's Station 311

Sampling Date	Precipitation			Average Temperature (°F)
	Day of Sampling	Day of + 1 Day Before	Day of + 2 Days Before	
7/18/2000	0.00	0.01	0.02	79
7/21/2000	0.01	0.36	0.80	72
8/1/2000	0.05	0.06	0.07	80
8/21/2000	0.01	0.01	0.02	63
9/11/2000	0.01	0.02	0.03	70
9/13/2000	0.00	0.00	0.01	72
10/13/2000	0.00	0.00	0.00	NA
10/18/2000	0.00	0.00	0.00	NA
11/13/2000	0.00	0.00	0.00	NA
12/12/2000	0.02	0.23	0.23	NA
12/15/2000	0.32	0.59	0.59	NA
1/22/2001	0.00	0.49	1.92	NA
1/23/2001	0.00	0.00	0.49	NA
2/1/2001	0.00	0.49	0.55	40
3/1/2001	0.00	0.01	0.01	31
3/15/2001	0.29	0.29	0.84	40
4/24/2001	0.01	0.01	0.01	70
4/27/2001	0.00	0.00	0.00	54
5/10/2001	0.00	0.00	0.00	67
6/7/2001	0.00	0.01	0.02	66
7/11/2001	0.00	0.05	0.05	73
7/23/2001	0.00	0.00	0.00	76
8/8/2001	0.00	0.00	0.00	74
9/5/2001	0.00	0.00	0.00	77

Sampling Date	Precipitation			Average Temperature (°F)
	Day of Sampling	Day of + 1 Day Before	Day of + 2 Days Before	
9/21/2001	0.05	0.15	0.15	74
10/3/2001	0.00	0.00	0.52	66
10/16/2001	0.03	0.20	0.28	59
11/13/2001	0.00	0.00	0.00	66
12/13/2001	0.01	0.03	0.17	54
12/17/2001	0.19	0.19	0.19	46
1/10/2002	0.00	0.00	0.00	45
1/18/2002	0.00	0.00	0.00	30
2/13/2002	0.00	0.00	0.00	32
2/14/2002	0.00	0.00	0.00	27
3/13/2002	0.29	0.34	0.34	47
3/14/2002	0.00	0.29	0.34	54
4/10/2002	0.12	0.51	0.51	51
4/25/2002	0.38	0.38	0.38	48
5/14/2002	0.00	0.33	0.99	57
6/12/2002	0.33	0.33	0.33	81
7/11/2002	0.00	0.00	0.55	66
7/24/2002	0.05	0.10	0.10	71
8/7/2002	0.00	0.00	0.01	67
9/4/2002	0.00	0.00	0.07	76
9/5/2002	0.00	0.00	0.00	71
10/7/2002	0.00	0.00	0.01	65
10/21/2002	0.00	0.01	0.01	50
11/18/2002	0.00	0.90	2.40	39
12/17/2002	0.00	0.00	0.00	29
12/19/2002	0.01	0.01	0.01	37
2/5/2003	0.00	0.01	0.01	28

Sampling Date	Precipitation			Average Temperature (°F)
	Day of Sampling	Day of + 1 Day Before	Day of + 2 Days Before	
3/18/2003	0.00	0.00	0.23	50
4/2/2003	0.00	0.00	0.01	51
4/28/2003	0.00	0.00	0.30	59
5/15/2003	0.04	0.04	0.04	53
6/12/2003	0.31	0.34	0.34	77
7/31/2003	0.15	0.17	0.66	72
8/12/2003	0.00	0.00	0.01	77
9/3/2003	0.07	0.10	0.15	73
9/8/2003	0.00	0.00	0.00	68
9/9/2003	0.00	0.00	0.00	68
9/16/2003	0.00	0.44	0.50	69
10/8/2003	0.00	0.00	0.00	61
11/12/2003	0.79	0.80	0.80	56
11/20/2003	0.27	1.87	1.87	50
12/9/2003	0.00	0.00	0.00	32
12/12/2003	0.00	1.58	1.59	36
1/6/2004	0.01	0.14	0.14	33
2/6/2004	1.18	1.18	1.18	41
3/23/2004	0.00	0.00	0.00	30
4/13/2004	1.60	2.75	3.02	51
4/22/2004	0.00	0.00	0.00	68
6/24/2004	0.00	0.00	0.01	74
7/6/2004	0.00	0.00	0.03	76
7/16/2004	0.00	0.00	0.40	73
7/29/2004	0.00	1.21	1.22	77
9/1/2004	0.00	0.29	0.31	70
9/13/2004	0.00	0.00	0.00	72

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

A total of 1,978 samples were collected and analyzed for Total Coliform (TC) from 51 sampling stations listed in Assignment 235 and Assignment 247. Both assignments were sampled under the Systematic Random Sampling Strategy.

This shellfish growing area consisted of the following shellfish water classifications: *Approved, Seasonal, Special Restricted, and Prohibited*. The majority of the sampling stations are positioned in *Approved* waters. There are 31 sampling stations situated in *Approved* waters, 14 sampling stations in *Seasonal* waters, and 6 sampling stations located in *Special Restricted* water. There are no sampling stations situated in *Prohibited* waters (see Figure 24).

This report includes data analyzed between July 2000 to September 2004 (see Table 7). The summary of all the raw data are provided in the Appendix. The National Shellfish Sanitation Program (NSSP) criteria can be found on Table 2 and Table 3.

COMPLIANCE WITH NSSP APPROVED CRITERIA

According to NSSP criteria for *Approved* classification, the geometric mean should not exceed 70 MPN/100mL and the 90th percentile should not exceed 330 MPN/100ml. Out of the 51 sampling stations analyzed for this report, none had exceeded the year-round, summer, and winter geometric mean or 90th percentile criteria (see Table 7). Therefore, all sampling stations are in compliance with their current shellfish classifications.

COMPLIANCE WITH NSSP SPECIAL RESTRICTED CRITERIA

The criteria set by NSSP for *Special Restricted* classifications are as follows: the geometric mean should not exceed 700 MPN/100mL and the Maximum 90th percentile should not exceed 3300 MPN/100mL. As stated above, there are only 6 sampling stations located in *Special Restricted* waters. None of these stations were out of compliance with NSSP *Special Restricted* criteria; therefore, they met their current shellfish classification.

FIGURE 24: SAMPLING STATIONS IN SHELLFISH GROWING AREA SE-4

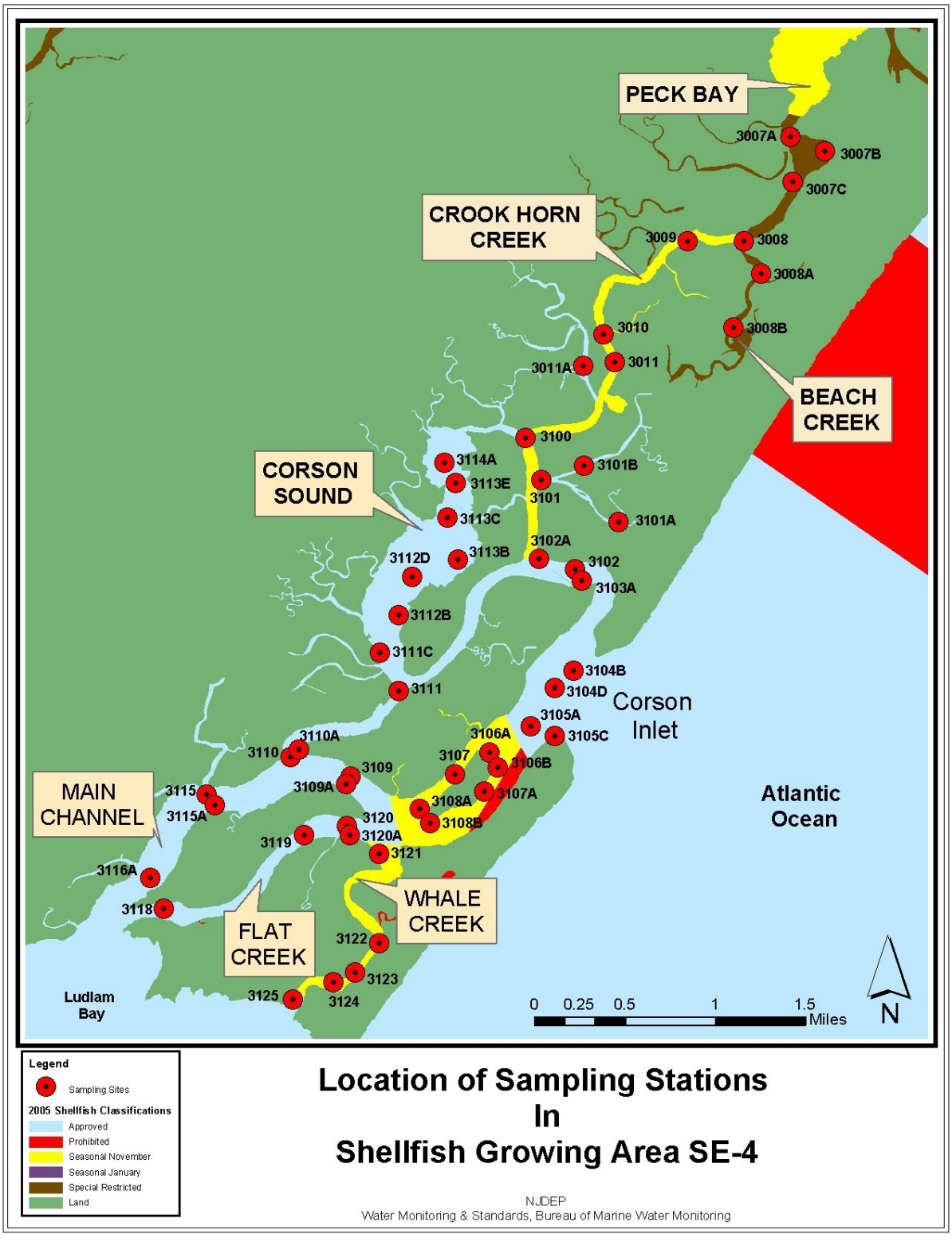


TABLE 7: TOTAL COLIFORM STATISTICAL SUMMARY (2000-2004)

Station	Status	Year-Round			Summer			Winter		
		Geomean	Est. 90th	N	Geomean	Est. 90th	N	Geomean	Est. 90th	N
3007A	SR	10.75	55.29	39	12.13	55.51	16	9.89	56.29	23
3007B	SR	9.89	66.03	38	11.31	43.97	16	8.98	83.87	22
3007C	SR	8.61	62.25	39	7.81	27.06	16	9.22	100.07	23
3008	SR	6.41	29.81	39	7.88	36.43	16	5.55	26.10	23
3008A	SR	8.21	40.76	39	10.62	46.51	16	6.86	36.73	23
3008B	SR	7.17	34.17	39	7.78	25.21	16	6.77	41.15	23
3009	S	4.68	12.27	39	4.90	12.39	16	4.53	12.41	23
3010	S	5.22	16.16	39	4.96	13.32	16	5.41	18.67	23
3011	S	5.12	19.72	38	5.56	20.93	16	4.83	19.38	22
3011A	A	3.68	6.73	38	3.93	7.35	16	3.50	6.36	22
3100	S	4.17	9.23	38	3.78	7.69	16	4.48	10.52	22
3101	A	4.59	17.00	38	4.46	14.73	15	4.67	19.05	23
3101A	A	5.38	21.16	39	4.32	9.74	16	6.27	32.32	23
3101B	A	5.79	22.06	39	5.39	16.86	16	6.08	26.75	23
3102	A	3.63	6.03	39	4.03	7.69	16	3.37	4.88	23
3102A	A	3.98	7.57	39	4.36	8.76	16	3.73	6.83	23
3103A	A	4.07	8.72	39	4.56	11.41	16	3.77	7.10	23
3104B	A	3.91	7.44	39	3.86	6.44	16	3.95	8.20	23
3104D	A	4.94	14.19	39	6.95	27.74	16	3.89	7.23	23
3105A	A	3.71	6.89	39	3.81	6.82	16	3.64	7.02	23
3105C	A	5.59	23.83	39	5.55	19.99	16	5.62	27.41	23
3106A	S	4.66	10.90	39	4.72	10.89	16	4.62	11.11	23
3106B	S	5.35	21.15	39	8.26	56.27	16	3.95	7.28	23
3107	S	4.44	11.41	39	4.28	9.28	16	4.55	13.17	23
3107A	S	5.11	13.99	39	7.41	24.36	16	3.94	8.04	23
3108A	S	4.79	12.63	39	5.94	20.86	16	4.12	8.09	23

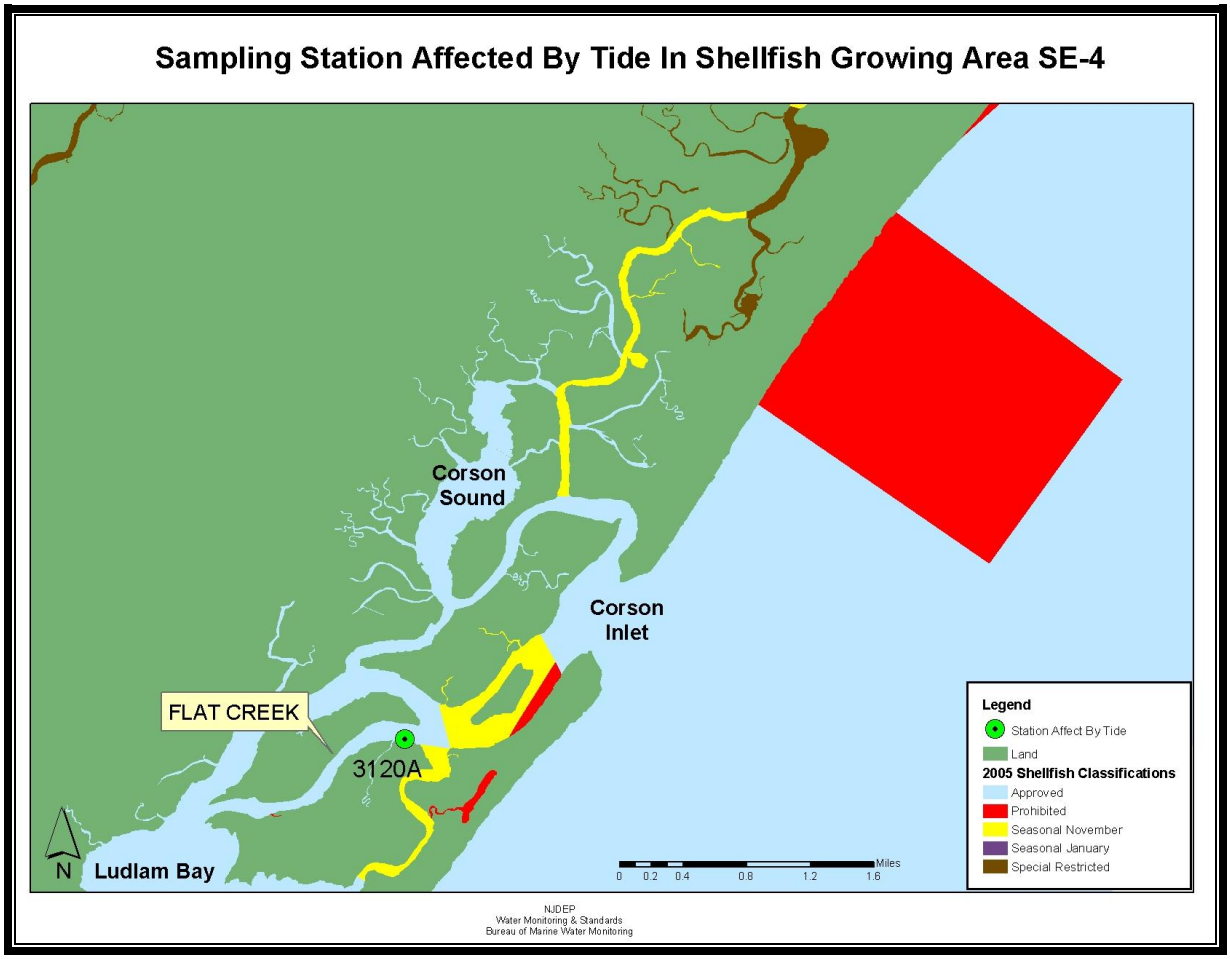
Station	Status	Year-Round			Summer			Winter		
		Geomean	Est. 90th	N	Geomean	Est. 90th	N	Geomean	Est. 90th	N
3108B	S	4.61	10.86	39	4.35	9.19	16	4.80	12.26	23
3109	A	5.64	22.65	39	5.90	30.02	16	5.47	18.83	23
3109A	A	5.81	20.69	39	7.89	39.48	16	4.69	11.67	23
3110	A	5.74	18.71	39	4.98	13.37	16	6.34	23.38	23
3110A	A	6.00	22.66	39	7.43	34.42	16	5.17	16.56	23
3111	A	6.15	24.37	39	8.29	46.81	16	5.00	13.93	23
3111C	A	5.67	16.63	39	4.64	8.99	16	6.52	23.29	23
3112B	A	5.94	30.27	39	6.32	38.42	16	5.69	26.37	23
3112D	A	7.29	32.35	39	7.97	40.22	16	6.85	28.51	23
3113B	A	6.39	25.01	39	5.86	27.14	16	6.78	24.04	23
3113C	A	6.12	24.29	38	5.43	19.44	16	6.67	28.97	22
3113E	A	6.40	31.01	37	5.83	24.66	15	6.82	37.06	22
3114A	A	4.60	11.79	38	5.03	12.00	16	4.32	11.74	22
3115	A	8.19	46.23	39	7.42	35.46	25	9.77	74.96	14
3115A	A	7.77	39.94	38	6.36	21.32	24	10.95	95.97	14
3116A	A	7.22	30.69	39	6.08	22.38	25	9.80	51.20	14
3118	A	8.65	48.88	38	5.96	22.20	24	16.38	131.51	14
3119	A	7.36	41.76	39	5.84	22.28	25	11.11	104.79	14
3120	A	4.51	9.14	39	4.63	8.69	16	4.43	9.55	23
3120A	A	5.79	15.08	39	5.19	10.76	16	6.24	18.66	23
3121	S	6.39	17.12	39	5.88	14.94	16	6.77	19.05	23
3122	S	7.29	30.35	39	5.41	11.90	16	8.98	49.39	23
3123	S	6.82	23.10	39	5.39	12.53	16	8.04	32.73	23
3124	S	8.45	51.12	39	5.17	15.92	16	11.88	93.38	23
3125	A	5.72	17.08	31	5.79	17.10	14	5.66	17.64	17

TIDAL EFFECTS

Tidal impacts were evaluated by performing a t-test using the Total Coliform MPN value. In order for a station to have a tidal component, t-probability must be less than 0.05, but not zero. To determine whether a station is affected by flood or ebb tide, the geometric mean from samples collected during ebb tide is compared with those collected during flood tide.

Out of the 51 sampling stations analyzed in this report, only one sampling station was influenced by tide. This station is situated in *Approved* waters of Flat Creek (see Figure 25). The t-statistic probability was calculated to be 0.033 and the geometric mean at ebb tide was 7.7 MPN/100mL and at flood tide was 4.6 MPN/100ml. This sampling station was affected by ebb tide.

FIGURE 25: SAMPLING STATIONS AFFECTED BY TIDE



RAINFALL EFFECTS

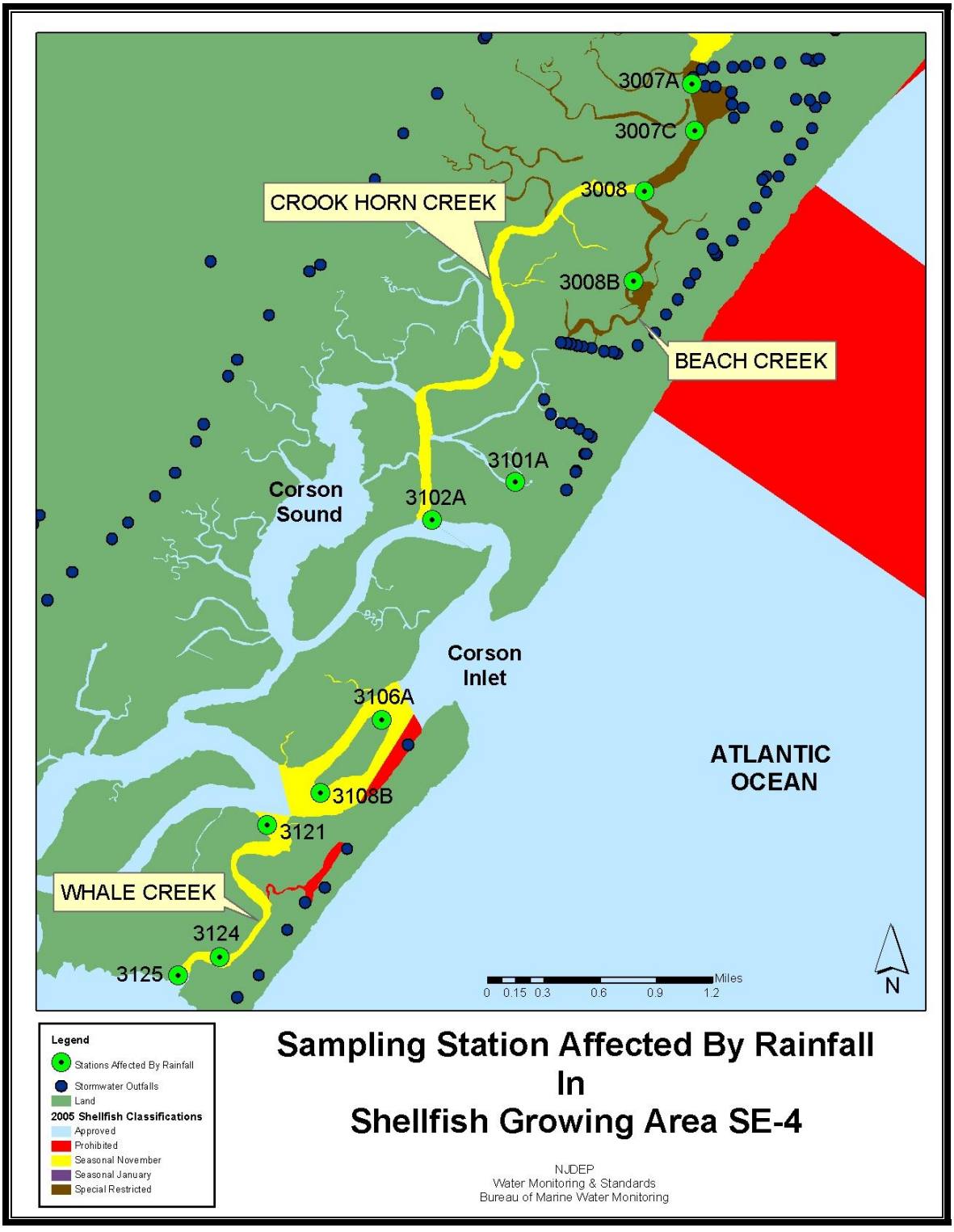
Non-point sources such as rainfall can put pressure on shellfish beds. The contributing factor is not from the amount of rainfall that fell, but rather from the materials that enter the water via storm drains during a rain event. These materials include bacteria, as well as other waste that enters the stormwater collection system.

Rainfall impact was assessed using a t-test to compare the Total Coliform MPN values from samples collected during dry weather versus samples collected during wet weather. The Wet/Dry Statistics were calculated based on a post-impact time of 48 hours and a wet/dry cutoff of 0.3 inches. Rainfall amount above 0.3 inches is considered to be a wet condition. A station is considered to be rainfall impacted when t-Statistic Probability is less than 0.05, but not zero. According to the data set analyzed for this report, there were 11 stations that were impacted by rainfall (see Table 8 and Figure 26).

TABLE 8: SAMPLING STATIONS AFFECTED BY RAINFALL

Station	Status	T-Statistic Probability	Wet GeoMean	Dry GeoMean	Wet/Dry Difference
3007A	SR	0.042	19.3	8.0	-11
3007C	SR	0.020	19.1	5.8	-13
3008	SR	0.017	12.1	4.7	-7
3008B	SR	0.015	13.8	5.2	-9
3101A	A	0.031	9.0	4.2	-5
3102A	A	0.023	5.1	3.5	-2
3106A	S	0.017	6.6	3.9	-3
3108B	S	0.041	6.3	4.0	-2
3121	S	0.014	9.7	5.2	-5
3124	S	0.049	15.8	6.2	-10
3125	A	0.042	9.3	4.7	-5

FIGURE 26: AREAS IMPACTED BY RAINFALL



SEASONAL EFFECTS

As the earth experiences variations in the tilt of its axis and its revolution around the sun, it goes through seasonal phases of summer, spring, autumn, and winter. These seasonal phases have much variation on the atmosphere of the earth, causing changes in weather patterns. Temperature, precipitation, wind, and the general circulation of the atmosphere have seasonal variations that also affect the marine environment (Ingmanson and Wallace, 1989).

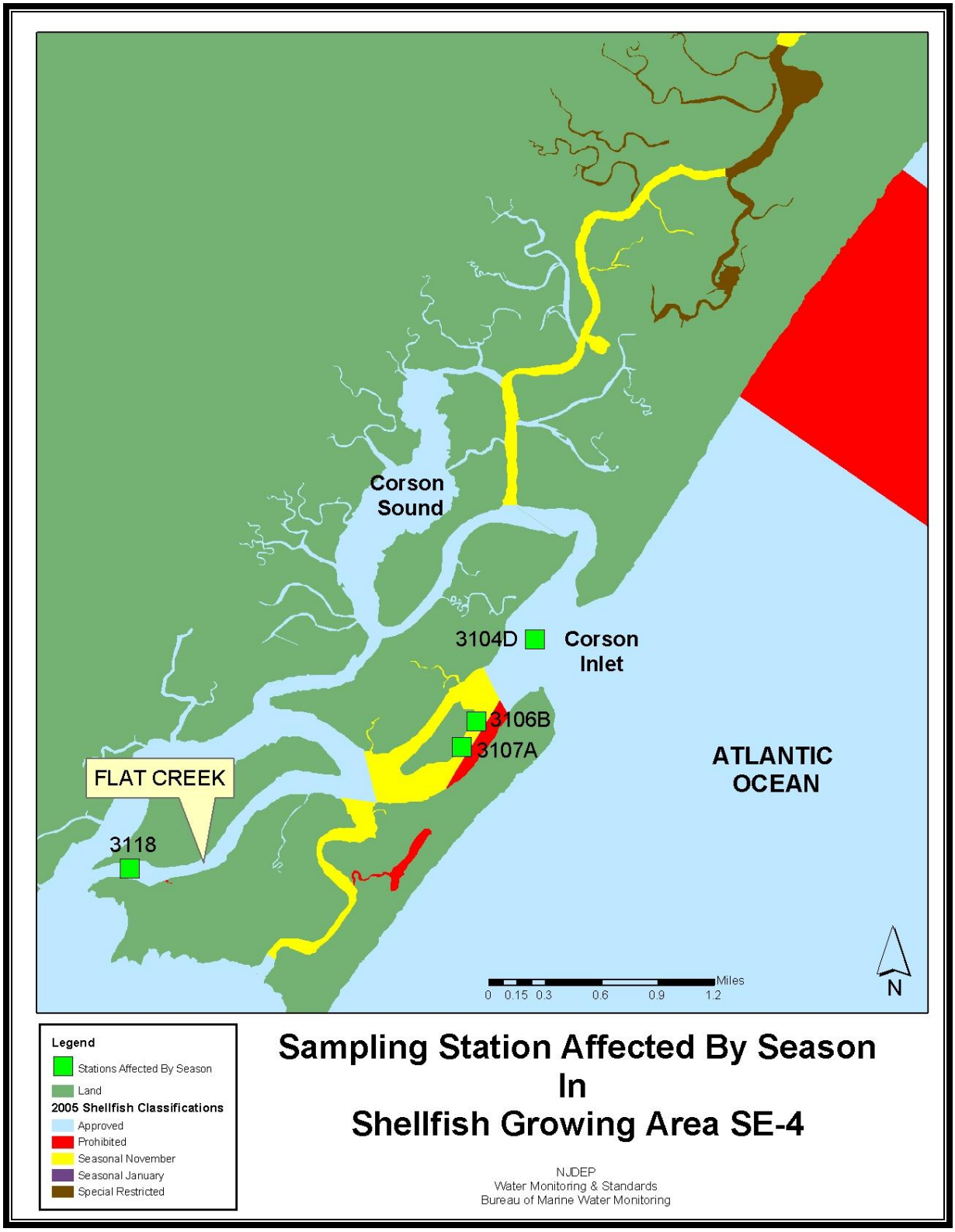
Seasonal variations also affect human activities, with generally more human activity in the warmer months of the year. An increase in human activities in or near the marine environment can have an impact on shellfish populations. Increased pressure from human activities on already stressed failing septic systems and overloaded wastewater treatment facilities can cause sewage to spill into the marine environment, which can negatively impact the water quality of a shellfish growing area by increasing the coliform levels in the water (Ingmanson and Wallace, 1989).

Seasonal effect was assessed using a t-test to compare the total coliform MPN values from samples collected during the summer season versus samples collected during the winter months. To have a seasonal component, t-probability must be less than 0.05, but not zero. Four sampling stations were affected by seasonal change in this shellfish growing area (see Table 9). These stations are located in Corson Inlet, Strathmere Bay, and Flat Creek (see Figure 27).

TABLE 9: SEASONAL STATISTICS

Station	Total Coliform Geometric Mean		Probability > [T]
	Summer	Winter	
3104D	7.0	3.9	0.029
3106B	8.3	4.0	0.033
3107A	7.4	3.9	0.012
3118	6.0	16.4	0.024

FIGURE 27: SAMPLING STATIONS AFFECTED BY SEASON



INTERPETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

The criteria for acceptability of shellfish growing water was based on the bacterial parameters set by the National Shellfish Sanitation Program (NSSP). Each state adopts either the Total Coliform criteria or the Fecal Coliform criteria for determining water quality.

The New Jersey Department of Environmental Protection had always based its water classification on the results generated from the total coliform test. Even though water classification is based on the total coliform criteria, the Bureau of Marine Water Monitoring does take corresponding samples for fecal coliform analysis. These data are, however, utilized as adjunct information and are not used for classification of shellfish growing waters. The NSSP criteria can be found on Table 2 and Table 3.

Out of the 51 sampling stations analyzed in this report, none were out of compliance with NSSP criteria for *Approved* or *Special Restricted* classifications. All stations met their current classifications of *Approved, Seasonal, Special Restricted,* or *Prohibited*. Even though, all stations meet the approved criteria, there were no recommendations made to upgrade *Seasonal*, *Special Restricted*, or *Prohibited* waters at this time. The *Special Restricted* or *Prohibited* waters found in this growing area acts as a buffer against any pollution source that might enter shellfish growing waters. For example, the *Prohibited* waters by Strathmere is placed there as a precaution for septic overflow.

Based on the statistical data, there were four sampling stations with a seasonal component. These were stations 3104D, 3106B, 3107A, and 3118. Station 3118 is situated by Flat Creek. The geometric mean for Station 3118 was higher during the winter. This is likely due to the bird population found in this area. In some areas, there can be hundreds of birds (mostly Brant) found sitting in shallow water. This explains why the geometric mean was higher during the winter months.

The other three stations were affected by the summer season. These stations are situated in Strathmere Bay. Strathmere is a tourist town, which means there are very few year-round residents. However, during the summer months, the population tends to increase, thus placing more pressure on septic systems that still exist in this area. There has been no report of any septic system failure reported to the Bureau of Marine Water Monitoring or to the Cape May County Health Department. However, there is always the possibility of malfunctioning septic systems that go undetected or are not reported to authorities. Beside malfunctioning septic systems, human activities also can cause impacts to water quality, like boating activities. These are some possible sources that are affecting water quality during the summer.

Rainfall impact was assessed by calculating the t-Statistic probability between wet and dry conditions. This area is surrounded by wetlands, which act as a barrier against pollutants. Therefore, it

would take a longer time for pollutants to reach shellfish waters. For this reason, post-impact time was set to 48 hours and significant impacts begin to occur when 0.3 inches or more of rainfall occurred over that 48 hour time period prior to sampling.

The data indicated that there were 11 sampling stations impacted by rainfall. The greatest differences in wet and dry geometric means were found in stations located in the *Special Restricted* waters of Crook Horn Creek and Beach Creek. These sampling stations are situated adjacent to urban areas, which mean there are little or no wetlands surrounding these stations to act as a barrier. When heavy rain occurs, bacteria as well as waste enter the stormwater collection system and are released directly into shellfish waters. The least differences in wet and dry geometric means are observed at stations that are somewhat protected because most of the pollutants that were released have been absorbed by the wetlands.

Station 3120A was impacted by ebb tide. This station is located at the intersection of Flat Creek and Whale Creek. Since there is less water during ebb tide, sediment below could have easily been stirred up toward the surface, thus increasing the bacteria count observed.

Even though there were sampling stations in this shellfish growing area that were affected by season, tide, and rainfall components, it was not necessary to downgrade waters. The bacteriological levels for these sampling stations were very minimal and the statistical data indicated that the geometric mean or MPN value for each of the sampling stations were far less than the criteria set by the NSSP.

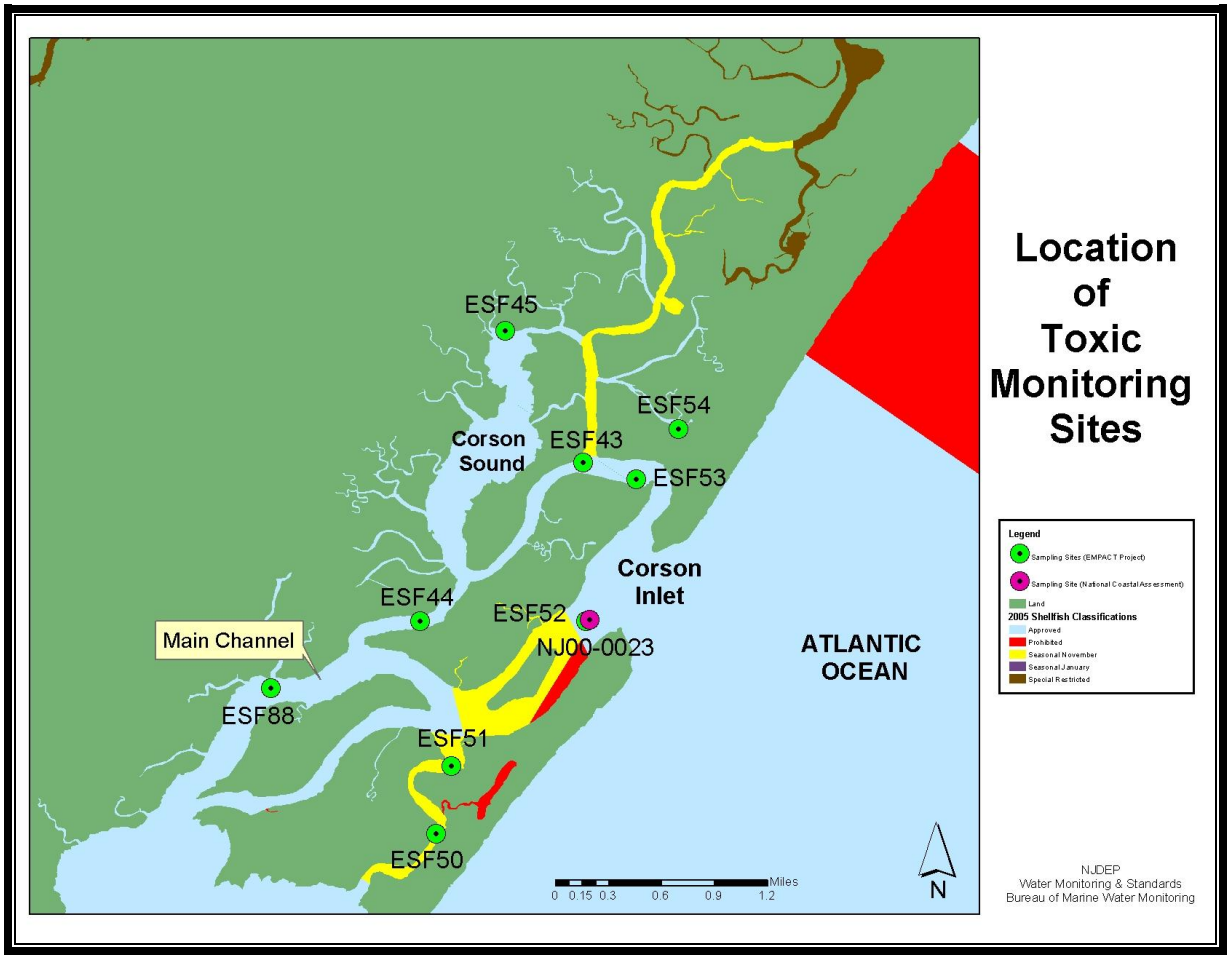
TOXIC CHEMICALS MONITORING

Toxic chemicals such as heavy metals, pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) are dangerous chemicals that can be found in the environment. These substances can be released into the environment by storm drains from industrial discharges, runoff from streets and farmland, sewage treatment facilities, and atmospheric deposition. These chemicals can also be found in sediment and can be resuspended into the environment through the process of dredging and boating activities. Bottom dwelling organisms are most vulnerable to these chemicals and may pose a risk to human health if consumed. Since the 1980's, the US EPA's National Coastal Assessment (NCA) and NOAA's Mussel Watch Project have been collecting sediment and tissue samples for toxic chemical analysis. These data can be obtained through the following websites: http://ccma.nos.noaa.gov/cit/data/ and http://www.epa.gov/emap/nca/).

The Bureau of Marine Water Monitoring does not routinely test for these chemicals or base its water classifications on these parameters. However, the bureau will test and monitor for these substances in the event of an oil spill or for special projects such as the Environmental Monitoring for Public Access & Community Tracking (EMPACT) project, where tissue samples were collected and analyzed for heavy metals, PCBs, PAHs, and pesticides. For additional information on the EMPACT project see http://www.nj.gov/dep/bmw/.

Figure 28 shows the location of the sampling sites that were visited in an attempt to collect samples. However, no resources were found at the time of sampling in this shellfish growing area.

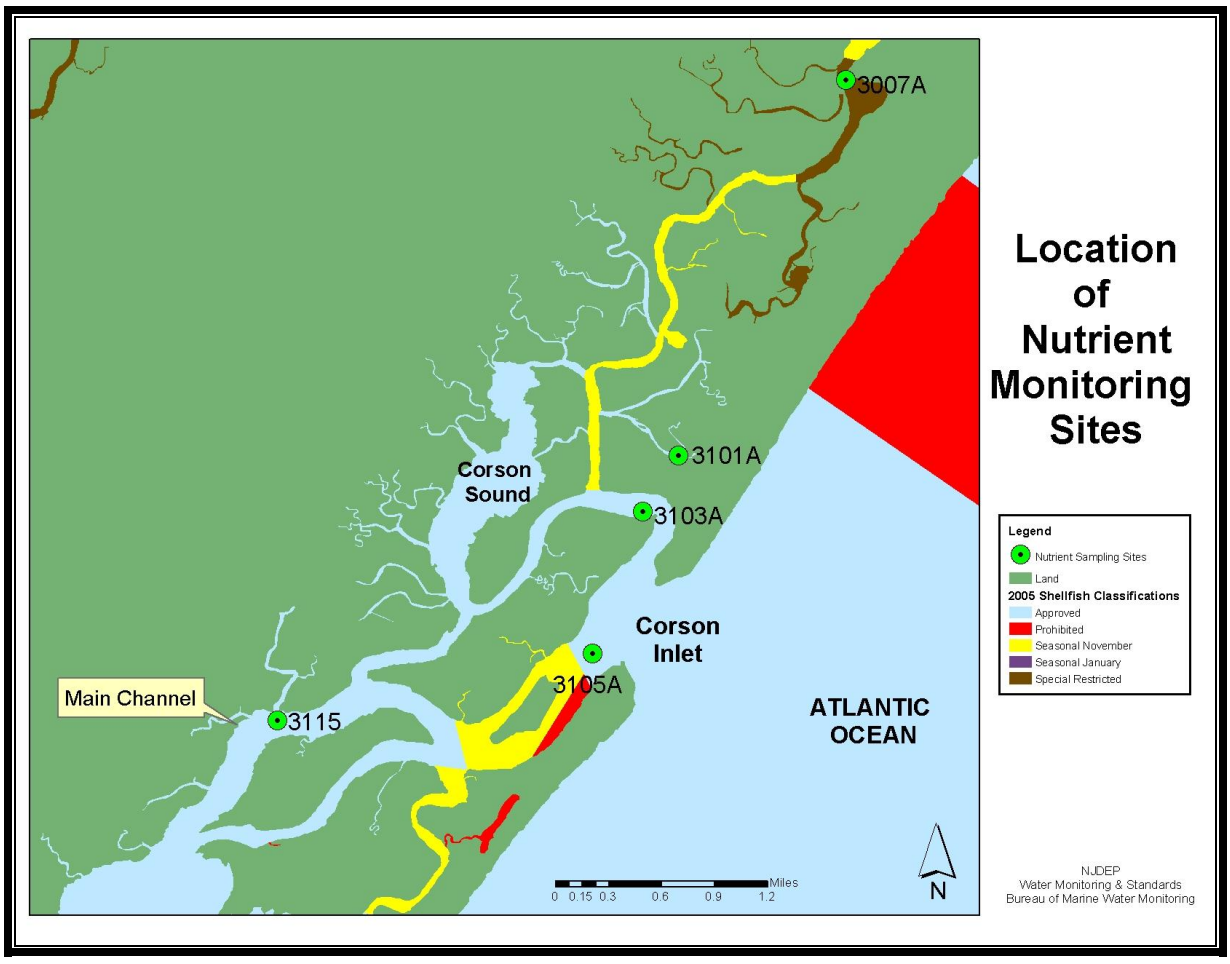
FIGURE 28: STATION TESTED FOR TOXIC CHEMICALS



NUTRIENTS

There are three stations in this shellfish growing area that are sampled under the estuarine monitoring program for chemical parameters, including nutrients. These three nutrient stations are 3101A, 3103A, and 3105A. Station 3101A is situated by Weakfish Creek and the other two stations are located by Corson Inlet. The location of these sampling stations can be found on Figure 29. More detailed information concerning dissolved oxygen and nutrient levels can be found in the Estuarine Monitoring Report published by the NJDEP. These reports are available from the Bureau of Marine Water Monitoring.

FIGURE 29: LOCATIONS OF NUTRIENT STATIONS



CONCLUSIONS

BACTERIOLOGICAL EVALUATION

Based on the water quality data obtained between 2000 and 2004, the results for all of the sampling stations were within NSSP *Approved* or *Special Restricted* criteria. At this time, it is recommended that current classifications remain the same.

RECOMMENDATIONS

SHELLFISH WATER CLASSIFICATION

There are no changes in the water classification recommended for the SE-4 area at this time. Continue the monitoring schedule as planned.

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New Jersey Department of Environmental Protection. http://www.state.nj.us/dep/

NOAA, National Climatic Data Center. http://www.erh.noaa.gov/

ACKNOWLEDGMENTS

This report was written under the direction of Robert Connell, Jr., Bureau Chief, and Leslie McGeorge, Administrator. Mike Kusmiez assisted in the collection and storage of statistical and GIS data used in analysis. Special acknowledgment is given to Captain Richard Rand for his perseverance in collecting shellfish water quality samples in the SE-2 area. This study would not have been completed without the analytical capabilities of our microbiology laboratory staff, including Eric Feerst (Supervisor), Lisa DiElmo, Elena Heller, Bruce Hovendon, and Bob Seabrook; and our chemistry laboratory staff, including Bob Schuster (Supervisor), Mike DeLeo, Dawn Thompson, and Stephanie Swanke.

APPENDICES

A. Statistical Summaries

   Year-round

   Winter Only

   Summer Only

B. Seasonal Evaluation

C. Precipitation

   Rainfall Correlation

   Cumulative Rainfall

   Wet Weather Statistical Summary

   Dry Weather Statistical Summary

D. Tidal Evaluation

E. Data Listing - 1998 through 2002